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Contents

PAGE

EDITORIAL NOTES: British Alkali Works; The Therapeutic Substances Regulations; The Merchant's Place in Trade; Colour Users and Foreign Dyestuffs; Russian Chemical Research 589
Chief Inspector's Annual Report on Alkali Works 592
Efficiency in Power Supply for Chemical Industry 595
Annual Meeting of Chemical and Dyestuffs Traders 598
CORRESPONDENCE: "The Organisation of Chemists" 599
Chemical Matters in Parliament; "C.A." Queries 601
From Week to Week 602
References to Current Literature 603
Patent Literature 604
Weekly Chemical Prices and Market Reports 607
Company News; New Chemical Trade Marks; Chemical Trade Inquiries; Tariff Changes 612
Commercial Intelligence; New Companies Registered 614

NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemica developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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British Alkali Works

ONE of the features of the annual report for 1926 on alkali works, a summary of which is published in this issue, is the continued decrease in the amount of ammonia products manufactured in this country. The quantity produced from gasworks liquor, which in 1924 stood at 151,161 tons and in 1925 at 148,945 tons, declined in 1926 to 132,477 tons. A similar decline is noted in the amount of ammonia from liquor produced in other works (including coke-ovens, ironworks, producer gas, synthetic, etc.), the figures being 211,019 tons in 1924, 201,667 tons in 1925, and 132,215 tons in 1926. Taking the total amount of ammonia products, the output for 1926 was 264,692 tons, as compared with 350,612 tons in 1925, and 362,180 tons in 1924.

The relatively high cost of recovery of sulphate as a by-product is reflected, it is pointed out, in the considerable drop in the number of works registered in recent years. In many instances, however, the plants still exist, so that under more favourable conditions they may again be brought into operation. The prolonged coal mines stoppage has obviously had a very adverse effect on the production of sulphate, the wholesale closing down of coke-oven plants involving non-production in these works for a considerable period. Gasworks were using other than their usual varieties of coal and were working under abnormal conditions generally, so that here also the effect was noticeable. The ammonia plant effluent problem has been under further consideration, and a body of full-time chemists of technical ability have now taken the matter in hand.

As regards sulphuric acid works, the report states that there has been little demand for concentrated acid, and that plants have been less active than formerly. Although electrostatic precipitation has been used for some time in connection with oleum plants and also in some concentrating plants, its possibility in connection with the latter does not appear to have been fully realised. In extension of the department's laboratory work, described in the previous report, it has now been possible to carry out a number of experiments on actual Gay Lussac tower exit gases. The object was to ascertain, as far as possible, what actually takes place under different conditions when Gay Lussac exit gases, normal and abnormal, are subjected to scrubbing with a limited amount of water. The results of the experiments are set out in detail in the report. As regards alkali works generally, the number registered in 1926 was 1,152, as compared with 1,177 in 1925 and 1,210 in 1924. The number of separate processes of manufacture under inspection has declined from 1,990 in 1924 and 1,928 in 1925 to 1,867 in 1926.

The Scottish report is on very much the same lines as that for England and Wales. The official figures supplied by manufacturers show that the amount of salts of ammonia produced from gasworks, ironworks, coke-ovens, producer gas, and shale works in 1926 was 58,800 tons, as against 78,905 tons in the previous year. The amount of tar distilled was 153,630 tons in 1926, as against 188,827 tons in 1925. The amount of pitch produced was 35,394 tons in 1926, compared with 54,265 tons in 1925. Incidentally, it is stated that Scottish coal has been found to yield nearly twice as much tar and ammonia as that obtained from imported coal. In the sulphuric acid industry production fell by another fifth, the loss being due to diminished recovery of ammonia compounds at blast furnaces and gasworks. There was a heavy fall also in the production of fertilisers. The prospects of the ammonia recovery industry are described as unattractive, the cost of the acid and the transport of crude liquor inducing many smaller works to run it wastefully to sea. The direct application to agricultural soil or an easier conversion to urea than at present is suggested as a possible method of the future.

Attention is called to a rather curious complaint by a municipal surveyor on the River Forth, of injury by fumes from a chemical works to stone work and glass work of public and other buildings. The corrosion of stone was found to be irregular, some pieces, save from blackening by coal smoke, being as good as when first built in; others near by were seriously decayed. Whether or not the chemical works had contributed to

the damage previously is regarded as doubtful. The window glass, it was complained, bore on its outward surface a permanent and iridescent bloom, not to be removed by careful cleansing and polishing. This complaint was found to be true. Adjacent panes were differently affected—in some, the iridescent bands being vertical, and in others horizontal, while they varied also in degree of intensity. This appearance was later observed throughout Scotland, even in districts free of chemical works. No conclusion has been reached on the matter, and the only suggestion is that the composition of the glass or the methods of manufacture or the increased acidity of the air may, perhaps, between them supply the cause.

The Therapeutic Substances Regulations

THE joint committee constituted under the Therapeutic Substances Act, 1925, has issued (under date May 31) the regulations which will govern the production and sale of substances specified in the Act. The substances included in the schedule are salvarsan (and various derivatives), insulin, vaccines, toxins and antigens (including reagents for the Schick test for diphtheria, tuberculins, etc.), sera, antitoxins, and pituitary extract. The regulations require that a licence must be obtained for the manufacture of the therapeutic substances set out, adequate provision being made for the inspection of the licensee's premises. If the substances are advertised or sold as a proprietary medicine, the "proper" name (as laid down in the regulations) must appear on the label. Provision is also made with regard to containers and labelling, to the standards of strength, quality, and purity to which the products must conform, and to tests for determining whether these standards have been attained. Imported substances will be required to conform to the regulations. The licensing authority is the Minister of Health in the case of England and Wales, the Scottish Board of Health in the case of Scotland, and the Minister of Home Affairs for Northern Ireland in the case of Northern Ireland. The regulations will come into force on August 6, except those regarding labelling, which will come into force on February 6, 1928. The Minister of Health has intimated to the Association of British Chemical Manufacturers, that in the initial period immediately after August 6 some latitude will be observed in the application of the regulations, so as to allow for the clearance of existing stocks, and for those concerned to become familiar with the new requirements.

It is mainly to insulin and the salvarsan group that chemical interest attaches, and in regard to the latter a very interesting point deserves to be noted. After enumerating the provisions relating to dihydroxydiaminoarsenobenzene, its sodium methylenesulphoxylate, and its sodium methylene sulphate (to be known respectively as arsenobenzene, novarsenobenzene, and sulpharsenobenzene), the regulations state that "in the case of any derivative of arsenobenzene other than those specified . . . the applicant for a manufacturing or an import licence shall submit to the Licensing Authority with his application a statement of the true chemical nature and composition of the derivative." This point seems to call for further elucidation. It is not usual in this country for the nature of a substance of genuine scientific therapeutic value to be kept secret. This does not hold good throughout the world; it is well known, for example, that the nature of certain German preparations has not been revealed. In disclosing the chemical composition of an important new derivative of "arsenobenzene" to the licensing authority, it seems possible that a British manufacturer might sometimes be putting himself at a disadvantage. Even though such substances are nearly always patented, this matter still deserves consideration. The ideal state of affairs would seem to be an international arrangement whereby the nature of all officially-recognised therapeutic substances would be disclosed. The importance attached to the new regulations in Germany is indicated by the fact that *Die Chemische Industrie*, the organ of the Union for the protection of German chemical interests, publishes a translation of the complete text of the regulations. The Therapeutic Substances Regulations will, no doubt, as experience of their working is gained, be extended or modified as may become necessary. It is clear, however, that their action may give rise to some very interesting developments.

The Merchant's Place in Trade

THE increasing difficulties that beset the chemical merchant were again emphasised both by the retiring chairman (Mr. Victor Blagden) and by the new chairman (Mr. F. T. T. Reynolds) at the annual meeting of the British Chemical and Dyestuffs Traders' Association last week. The difficulties come from three directions—from legislative and departmental restrictions on imports, from the direct control of sales and distribution by manufacturing firms themselves, and from the growth of large groups of manufacturing interests, the greatest example of which is the recent formation of Imperial Chemical Industries. The merchant is essentially a free lance, exploring every avenue of trade open to him in competition with both manufacturing and merchanting rivals, but even he has now been driven by force of circumstances to combine for his own defence, so as to be able to act collectively where collective action on the part of others threatens his interests. In this he has been successful to the extent of having established an Association that can now speak for the merchant community, and obviously the larger the number of traders it represents, the greater must be the weight with which the Association speaks.

It is clear that between the merchant who desires the fullest possible freedom from restrictions and the manufacturer who desires to eliminate the merchant altogether there can be very little common ground, and it is the merchant's constant complaint that the Government and its administrative machinery favour the manufacturer to the merchant's detriment. On this point the parties charged must present their own defence. The official is usually quite a neutral type of mind, which carries through whatever instructions it is under; the real point is that recent legislation and regulations are definitely designed to restrict the merchant's free activities in imports and to favour home production. The policy is clearly expressed in the Dyestuffs Act, in the Safeguarding Acts, and in the Trade Facilities

grants to great new undertakings like Synthetic Ammonia and Nitrates, Ltd. There is, however, a distinct distance between trying to restrict importation for the specific purpose, for example, of developing a national dyestuffs industry, and seeking to put the merchant out of action altogether. Diminished though his field has been in recent years, there must always remain a certain margin of trade in which the merchant can operate, and he is entitled to say that this trade is not only to his own interest but of interest also to the shipping industry and to trade generally; and, moreover, to contend that free competition is a definite factor in keeping down prices to the consumer. These points were all made very clearly in last week's speeches, and seem fairly entitled to consideration.

Colour Users and Foreign Dyestuffs

ONE of the most interesting points dealt with in the annual report of the Colour Users' Association, to be presented to the annual meeting next week in Manchester, is the reference to the recent survey of the dyestuffs situation on the Continent. From the data obtained by the Association's representatives, the conclusion was drawn that prices generally were lower on the Continent than in England. Particularly did this apply to vat dyes and imported German colours in France, where a duty is payable on all imported colours except German reparation dyestuffs, and where, irrespective of price, no foreign dyestuff of which an equivalent is made in France can be imported. In Italy the prices compared "not unfavourably" with our own, though the vat colours were lower. The wages paid were considerably lower. Colour prices in Switzerland were found to be slightly higher than here, with the exception of vat colours. The German dyestuff manufacturers asserted that their prices for dyestuffs used in Germany were, approximately, 60 per cent. to 70 per cent. above the pre-war level, and that a similar state of things existed in Holland. Great difficulty was experienced in getting direct access to colour users in Belgium, and reports of prices varied considerably.

The establishment of contact with continental users and associations is regarded as an important achievement, and one suggestion, arising from the visit, is that representatives of the textile trade should be established in competitive countries such as France, Italy, and Germany, the present Consular and Overseas Department representatives being unable, in the opinion of the deputation, to give to the textile trade the attention it deserves as the leading export trade of Great Britain. Another matter which the deputation carefully considered was the possible effect of the amalgamation of dye manufacturing concerns on the position in this country as regards the Dyestuffs Act. The annual report contains numerous other points of interest which will no doubt come up for discussion at the annual meeting. Among the subjects with which the Chairman proposes to deal is that of the "Fadeless Dye" guarantee, another example of the increasing attention that this problem of colour fastness is receiving.

The report contains the reasons which induced the Association to urge the reduction of the "price factor" from 2½ times the pre-war price to 2, but, as announced recently, this change has already been determined on, and will come into effect in September next.

Russian Chemical Research

PART 9 of Vol. 58 of the Journal of the Russian Chemical Society, covering a total of 222 pages, contains 21 communications, which are of the usual high standard. This part concludes Vol. 58 and contains also the author and subject index. The analysis of this index shows that 124 original papers, covering a total of 1,397 pages, were communicated to the Society during 1926, which compares favourably with other scientific journals.

Special reference must be made to a very interesting paper from the laboratories for tinctorial chemistry of the Technical High School at Moscow, by P. P. Victorow and S. N. Sirkine (pp. 1,351–1,361). These authors have compared the mordanting properties of synthetic digallic acid with those of natural gallotannin and have come to the conclusion that they are in every respect the same. This concludes a very interesting chapter in organic chemistry. It was suggested by Schiff as far back as 1871 that gallotannin contains a digallic acid nucleus, and this was confirmed by Nierenstein, who isolated digallic acid from gallotannin in 1910, and by Emil Fischer, who synthesised this compound in 1912. It was also found by Nierenstein in 1912 and by Zetsche in 1923 that the tanning as well as the ink-producing properties of digallic acid are the same as those of gallotannin, and the same conclusion has now been reached by the Russian chemists as to the mordanting qualities of these two compounds. All this goes to show that the chemistry of gallotannin, which has attracted Scheele, Mussin-Pushkin, Davy, Liebig, and Berzelius, in addition to the other chemists already mentioned, has reached agreement as far as the presence of the digallic acid nucleus in gallotannin is concerned. The work of Victorow and Sirkine is, therefore, a valuable addition to the whole question, as it establishes one more conclusive point of this very involved problem.

Books Received

63RD ANNUAL REPORT ON ALKALI, ETC., WORKS. By the Chief Inspectors. Proceedings during the year 1926. London: H.M. Stationery Office.

REPORT ON THE WORK OF THE MINING RESEARCH LABORATORY OF THE UNIVERSITY OF BIRMINGHAM for the year 1926. By the Executive Board of Mining Research. Birmingham: D. McMichael.

The Calendar

June 28	*Colour Users' Association: Annual* General Meeting. 12 o'clock noon.	*Blackfriars House,* Assembly Room, Manchester.
29–30	North of England Institute of Mining and Mechanical Engineers: Annual General Meeting.	Newcastle-on-Tyne.
July 1		
4–8	Society of Chemical Industry: Annual General Meeting.	Edinburgh.
Aug. 31–Sep. 7	British Association for the Advancement of Science: Annual Meeting.	Leeds.

Chief Inspector's Annual Report on Alkali Works

Reduced Output of Ammonia Products

We give below extracts from the 63rd annual report on alkali works in England and Wales for the year 1926 by the chief inspector (Dr. T. Lewis Bailey) and from the corresponding report for Scotland by Mr. J. W. Young.

THE total number of works registered was 1,152, which entailed the inspection of 1,867 separate processes; there was thus a reduction of 25 in the number of works and of 61 in the number of processes as compared with the previous year. No works were found operating without having been registered.

The number of visits of inspection by the district inspectors to registered works during the year was 3,661, in the course of which 2,068 quantitative estimations of the noxious constituents of chimney and other gases, escaping from the processes in operation, were made.

Investigation of Complaints

In addition to the work of inspection, it has been necessary for inspectors to investigate a number of complaints, which, it was found, concerned processes that are not registrable under the Act, and in two instances the assistance of the inspector was sought with a view to the abatement of the nuisance. In recent years this has happened on a number of occasions, and it has been possible to ameliorate the conditions existing in the neighbourhoods from which the complaints have come.

As new processes, in which noxious or offensive gases are evolved, are brought into use, in addition to the processes enumerated in the First Schedule to the Alkali, etc., Works Regulation Act, 1906, it is desirable that they should be brought under inspection. Section 4 of the Public Health (Smoke Abatement) Act of 1926, which has recently been passed and will come into operation on July 1, 1927, enables this to be done from time to time, the Act prescribing that "the Minister of Health may, after a public inquiry and after consultation with any local authorities or other interests concerned, make orders: (*a*) extending the list of noxious or offensive gases mentioned in section twenty-seven of the Alkali, etc., Works Regulation Act, 1906; and (*b*) extending the list of works mentioned in the First Schedule of the said Act; and any such order may prescribe the qualifications subject to which subsection (1) of section seven of the said Act shall apply in the case of any noxious or offensive gas, or in the case of any works, included in such order." Furthermore, under the Act an inspector may be authorised to enter and inspect any work which is likely to cause the evolution of any noxious or offensive gas, notwithstanding that the Alkali, etc., Works Regulation Act, 1906, may not apply to such work. The necessary investigations can thus be made before it is decided whether any such work should be brought within the provisions of the Act of 1906.

The number of complaints received during the year from outside sources was 14, considerably fewer than during the previous year. Four of these related to processes not subject to registration. In two of them dust was essentially the cause of the nuisance; the district inspectors discussed working details with the works managers, and conditions appear to have been improved.

Of the cases of nuisance alleged against registered works, only one was of a serious nature, and it was due to the fact that repair of a subsidiary flue was being carried out when the main process was in operation, the result being the emission of an excessive amount of sulphur dioxide. It was not considered necessary to proceed to prosecution: a strong letter of warning was, however, addressed to the company owning the works.

The prolonged stoppage of the coal mines brought with it, of course, general cessation of the manufacture of coke in coke ovens—a fact which is reflected in the statistics for ammonia and tar by-products. To a large extent, however, chemical works in general continued to operate, only the importation of coal enabling them to do so. The operations were of necessity on a reduced scale, so that many units of plant were idle. In many instances the opportunity was taken to carry out repairs in order that plant might be fully equipped against such time as improved industrial conditions arrived. Large-scale research work continued.

Alkali and Copper (Wet Process) Works

The number of these works was 46, which is 5 less than last year.

The Leblanc process for the manufacture of saltcake and hydrochloric acid continues to be operated steadily. Conditions remain good from the Alkali Act standpoint; plants are carefully operated, and there is more and more tendency to increase the efficiency of acid recovery so far as this is possible with the small margin existing. Low-level escapes of acid fumes are fewer, which means not only a still cleaner atmosphere in the neighbourhood of the works but also better working conditions for those operating the furnaces. The newer modifications of mechanical furnaces are still on their trial. Silica ware for the condensation of hydrochloric acid is making headway to some extent. Copper (wet process) works are still operated only to a very limited extent.

Cement Works

These works were very actively engaged until the price of fuel became prohibitive. The activities of chamber kilns were in particular curtailed as the coke supply became more and more reduced. A further number of 250-foot rotary kilns were brought into operation during the year. In the latest designs provision is made for passing the coal dust from the coal-drying and grinding plant to the kiln with the hot-air blast, thereby removing a possible source of nuisance; the adoption of induced draught by fan, to supplement chimney draught, is extending. There has been an absence of complaints of either smoke or dust, during the year under review, from registered cement works. In some works special means are adopted for preventing emission of dust in grinding, etc.

Smelting Works

The average acidity of the gases from the chimneys of these works is steadily getting lower. The satisfactory treatment of the gases evolved in the roasting of zinc blende, referred to in last year's report, continues. It is desirable that we should be able to advance a step further and be able to deal with certain calciner gases lower in sulphur dioxide content than those already undergoing treatment. The gases from sintering processes, for instance, have a comparatively low average acidity; they are usually of necessity accompanied by a very large excess of air and are frequently very dusty. It is thus evident that the problem of dealing with them is beset with many difficulties. There is some sign of progress, but so far it does not go beyond a partial recovery in special cases, and we must await the development of further efforts.

Two cases of somewhat high acidity of the gases from works calcining tin ores have engaged the attention of the district inspector concerned. In one case satisfactory results have been attained by causing the gases to be washed with alkaline (lime) showers before they reach the chimney. The other case is not so simple, largely owing to the situation of the works: at this works, however, much has been done in recent years in the way of recovering metallic fumes, and proposals have now been made which, it is hoped, may effect considerable improvement as regards acidity of chimney gases without undue working cost.

Two complaints were received against smelting works during the year. In one instance a new process was being started and for a while the most satisfactory conditions could not be attained; the other complaint related rather to unpleasant smells from the works, which are in the immediate vicinity of dwelling houses.

Sulphuric Acid Works

The operation of sulphuric acid units has given no cause for complaint: the few infractions noted have been due to quite temporary disorganisation. The average total acidity of exits from these plants was 1·08 in terms of SO_4 grains per cubic foot; the highest average for any one plant was 2·71 and the lowest 0·28.

In last year's report, after a consideration of various points in connection with the lead chamber reactions, with special reference to nitre consumption, attention was drawn to the

possible conditions existing in the neighbourhood of steam jets and water sprays. In this connection it is of particular interest to be able to record the experience of Dr. J. Fischler, Trzebinia, Poland, who has given his experience of the use of acid sprays instead of water sprays over a period of three years (*Zeits. f. angew. Chemie*, 39, 55, January 14, 1926). He says the change has brought with it not only advantages as regards the average concentration of the acid formed, but, in addition, the average nitre consumption has fallen considerably, notwithstanding the increased output per unit of chamber space.

In extension of our laboratory work described in last year's report, it has now been possible to carry out a number of experiments on actual Gay Lussac tower exit gases. The desire was to ascertain, as far as possible, what actually takes place under different conditions, when Gay Lussac exit gases, normal and abnormal, are subjected to scrubbing with a limited amount of water.

Research on Gay Lussac Gases

The apparatus employed consisted of a laboratory type of tower-scrubber, packed with broken pieces of hard glass tubing, followed by a train of Drechsel's bottles. The scrubber was fed with water or with dilute sulphuric acid, as desired; the Drechsel's bottles were charged with hydrogen peroxide and water. A duplicate train of absorbers, charged throughout with hydrogen peroxide and water, afforded a means of determining the total weight of acid entering the system. It was found that:—

(i) In every case there was apparent loss of acid in the waterfed scrubber. In three experiments, where the weight of sulphur acids was determined by precipitation with barium chloride, in addition to the total acidity of the condensed acids of sulphur and nitrogen by titration with caustic soda, the loss of acid was found to be due to a deficiency of nitre acids, which indicates that SO_2 had reacted with NO or with NO_2 in presence of water to form H_2SO_4 and N_2O.

(ii) When the total acidity of the entering gases was low, say, under 2 grains, stated as SO_3 per cubic foot, there was recovery of nitre acids in the water scrubber, the nitre acids being in excess; with higher acidities nitre acids were absent from the condensate obtained in the water scrubber, the SO_2 being in excess. The efficiency of the water scrubber as regards absorption of SO_2 and recovery of nitre acids was highest when the total acidity of the entering gases was low.

(iii) The efficiency of the scrubber, when fed with dilute sulphuric acid of 7° Tw., approximated to that obtained when water alone was used. With higher strengths of sulphuric acid, say, over 14° Tw., the efficiency of the acid-fed scrubber was markedly lower. This is attributed to the fact that the reducing action of SO_2 on the nitre gases is greatest in presence of water: it is inhibited by acid of 14° Tw. and upwards.

In presence of dilute sulphuric acid, therefore, there is no reduction of NO or NO_2 to N_2O, and any reduction of acidity of the exit gases effected under these conditions is attributed to the absorption of SO_2, as such, and to the fixation of nitre gases in the form of nitrous and nitric acids.

It has further to be remembered that experiment indicates that such fixation of nitre gases is most readily and completely effected when sulphuric acid is absent. This further emphasises the importance of so working the water scrubber as to maintain the strength of the sulphuric acid in the effluent liquor at a minimum, certainly at a strength not exceeding the 8° Tw. favoured by Messrs. Miller and based on working practice.

Incidentally, one may record an experience which is of peculiar interest from a different point of view. The exit from a tower type of vitriol plant was of a particularly unpleasant character, although its total acidity was consistently under 1 grain, stated as SO_3 per cubic foot. Complaints were made by the occupiers of a neighbouring property. With a view to further reducing the acidity of the gases, they were passed through a coke-packed tower fed with a limited supply of water, 25-30 gallons per hour. The acidity of the gases was thus reduced to 0·2-0·3 grain, and they no longer possessed their offensive character.

There has been little demand for concentrated acid, and plants have been less active than formerly. At only one of these works has there been any cause for dissatisfaction; exit acidities were there found running too high. Fan draught was not satisfactory and this was altered, with resulting improvement, though still scarcely sufficient to make good results certain. A new scrubber is, therefore, being installed. Although electrostatic precipitation has been used for some time in connection with oleum plants and also in some concentrating plants, its possibilities in connection with the latter do not appear to be fully realised. Results have been recorded in recent years showing that 3-grain concentrator fumes can be reduced by this means consistently to 0·2 grain, all visible fume disappearing at the same time.

Chemical Manure Works

Eighty works are registered for this process, which is 16 fewer than two years ago. At the major portion superphosphate is made; the remainder consist of bone-dissolving works, flesh manure works, etc. Superphosphate manufacture is still on a considerably reduced scale, as it has been for several years past. Where it has been carried on, operations have been conducted with the usual excellent condensation of acid gases, except in one instance, which came under notice towards the end of the year at a works where a new mixing plant had been provided with a fan that was much too powerful for the purpose for which it was intended.

It was necessary to refer to the design of scrubbing plant for chemical manure works in the 58th annual report, and again in the 59th annual report, with special mention of fan draught, and it is disappointing that attention should again have to be directed to this same point.

In almost all works the acidity of the escaping gases, stated as the SO_3 equivalent of hydrofluosilicic acid, has not exceeded 0·1 grain per cubic foot. The highest percentage condensation of acid gases for any one works was 99·9, the lowest 95·9.

Sulphate of Ammonia and Gas-liquor Works

The relatively high cost of recovery of sulphate, as a by-product, is reflected in the considerable drop in the number of works registered in recent years. In many instances the plants still exist, so that under more favourable conditions than prevail at present they may again be brought into operation.

The prolonged coal mines stoppage of 1926 has had a very adverse effect on the production of sulphate of ammonia. The wholesale inevitable closing down of coke-oven plants involved non-production in these works for a considerable period; gas works were using other than their usual varieties of coal and were working under abnormal conditions generally, so that here also the effect was noticeable. The plants that have operated have been conducted satisfactorily, and purifiers in general have been kept in good order.

The ammonia plant effluent question having reached a stage where it was considered necessary that more complete investigation and experiment should be carried out in the works themselves, a sub-committee was appointed by the Institution of Gas Engineers to carry on such work, and full-time chemists of technical ability have now taken the matter in hand.

At several works the evaporation of devil liquor in waste heat flues has been adopted, together with carefully regulated flow of the remaining effluent liquor to the place of disposal. Substitution of an acid wash, in place of the final water scrubbing of coal gas, is also showing signs of development. Increased attention is, moreover, being directed to the beneficial effect of the more complete separation of tar at the initial stages of coal-gas purification, together with early and complete separation of the tar from any accompanying liquor.

Further work has been done in this laboratory during the year. It has been found possible to evolve a more satisfactory method of estimating the relative contamination of effluent liquors with higher tar acids, and good results have been obtained in the removal of phenol from effluent liquors by using a trough, in a waste heat flue, instead of the isolated tower previously employed.

The results of the analysis of condensates obtained at two coke-oven plants are of sufficient interest to be given in detail. With respect to the figures here given, particular attention may be drawn to the progress of separation of phenol from the gas.

At Works A, 91 per cent. of this is found in the water-tube condensate in less than half the total liquor produced, the

remaining 9 per cent. being found in the water-scrubber liquor, which was fully half the total liquor.

At Works B, 16 per cent. was caught in the atmospheric coolers in 8 per cent. of the total liquor, 65 per cent. in the water-tube condensers in 38 per cent. of the liquor, and 18 per cent. in scrubbers in 54 per cent. of the total liquor.

In the case of Works A the last two columns show the effect of even comparatively short storage on the thiosulphate and thiocyanate content of the ammoniacal liquor.

Investigation of the ammonia plant effluent from one gas works with vertical retort system proved to be of very special interest. No less than 46 per cent. of the oxygen absorbed is due to phenol, and 47 per cent. to other bodies than phenol, thiosulphate, and thiocyanate, and from the aeration test it may be concluded that the major portion of this "difference" figure is due to higher tar acids, which are capable of being largely kept out of the liquor, if suitable methods of tar separation in the early stages of the coal-gas process are adopted.

Chlorine Works

The number of chlorine works registered has increased from 37 to 49 during the past two years. The use of liquid chlorine in the manufacture of various products, inorganic and organic, and for other purposes continues to extend; this is responsible for the increased number of works of this class that have been registered. In some works quite a large number of units of chlorinating plant are in constant use.

Complete absorption of any excess chlorine is essential, by reason of its exceedingly noxious character. This can be efficiently effected by means of towers fed with soda solution, the liquor being recirculated and a useful hypochlorite thus obtained. All processes in which chlorine is used need careful supervision in every detail to ensure the absence of chlorine escape either from the pipes conveying the chlorine to the process or from the process itself.

Muriatic Acid works: Fibre Separation

Emission of hydrochloric acid from these works has been kept down to a very low limit, and plant has been maintained in good order. Only one complaint was received, and that related not to hydrochloric acid but to dust from "carbonised" rags. The district inspector suggested means for abating the nuisance.

Muriatic Acid Works: Tinplate Flux

The conditions under which the scruff from tinplating operations is treated are now such that there is little difficulty in preserving a perfectly satisfactory atmosphere in the neighbourhood of the works, the amount of hydrochloric acid emitted being negligible. Occasionally a little pressure has to be brought to bear on those responsible for carrying out the operations, but, speaking generally, results have been very satisfactory.

Sulphide Works

These have all been well conducted. Complete absorption of any sulphuretted hydrogen is not accompanied by serious difficulties; proper supervision is, however, always necessary, and it is worthy of note that supervision has been good. There has been no further adverse comment to make regarding the work especially complained of in last year's report.

Venetian Red Works

There was cause for remonstrance at one works where copperas is roasted—this is referred to in the early portion of this report. Other venetian red works have all operated without offence throughout the year, the acidity of the evolved gases being satisfactorily reduced before their emission to atmosphere.

Tar Works

Several complaints were made to district inspectors as to excessive fumes from tar works. They related, however, not to anything given off in the actual distillation process, but to offensive fumes, carrying to considerable distances, from bitumen-mixing plants, which have come more into vogue in recent years owing to the modern methods of road surfacing. Much depends on the type of mixer used. With a mechanical mixing arrangement there is considerably less liability to evolution of fume than in the case of air blowing. In any case, fumes can quite well be draughted by means of a fan to a suitable condenser. Where this has been done, nuisance has ceased.

The Scottish Report

The number of works registered was 154, in which were operated 292 scheduled processes. I made 475 visits to these works, and 27 to others not on the register: in the course of my duties I performed 252 chemical tests of escaping gases: in no case were exceeded the limits of acidity prescribed by the Act. No legal proceedings have been taken.

Three works were discovered to be operating a scheduled process, "bisulphite," without previous registration. The owners pleaded their ignorance of the Act, admitting that their manufacture had extended throughout many years. Their offence was condoned, after some hesitation in one case, on payment of fees for two past years.

Complaint by the Burgh Surveyor of a town on the River Forth was made against a chemical work of injury, by fumes emitted, to stone-work and window glass of public and other buildings. The corrosion of stone was irregular; some pieces, save from blackening by coal smoke, being as good as when first built in; others near by were seriously decayed. It was evident that the stone had been improperly selected. Whether or not the chemical work had contributed to the damage previously is doubtful, but through inactivity it can have had no recent share. The acids of coal smoke and the damp winds from the sea afford reasons sufficient.

The window glass, it was complained, bore on its outward surface a permanent and iridescent bloom, not to be removed by careful cleansing and polishing. This was true. Adjacent panes were differently affected—in some the iridescent bands were vertical, in others horizontal; they varied also in degree of intensity. This appearance later has been observed throughout Scotland, even in districts free of chemical works. The composition of glass, or methods of manufacture, or the increased acidity of the air, may perhaps between them supply the cause.

By the courtesy of manufacturers, I am able to present the usual summary of raw materials and of products. It bears witness to the depressed state of trade, especially in the production of iron and of its associated industries:—

Pyrites Blende and Spent oxide burned for Sulphuric Acid:—

In 1926	79,438 tons.
In 1925	100,865 ,,

Phosphates and Bones dissolved for fertilisers:—

In 1926	43,130 tons.
In 1925	59,279 ,,

	Salts of Ammonia. Tons.	Tar distilled. Tons.	Pitch produced. Tons.
From gas works	18,719	132,522	25,053
,, iron works	816	11,114	5,418
,, coke ovens	2,965	6,777	3,067
,, producer gas	2,405	3,217	1,856
,, shale works	33,895	—	—
Total 1926	58,800	153,630	35,394
In 1925	78,905	188,827	54,265

The ammonia is expressed as pure sulphate; 776 tons were obtained as concentrated liquor ammonia and 323 tons as ammonium chloride. About 90,000 tons of tar were dehydrated and partially distilled for road purposes. Scottish coal is said to yield nearly twice as much tar and ammonia as that obtained from imported coal.

Alkali Works

Excepting at one works, idle during a long period, operations were not more restricted than in 1925, notwithstanding adverse conditions. Hydrochloric acid was readily absorbed by other industries, and saltcake chiefly exported.

The general average amount of hydrochloric acid discharged into the air was in each cubic foot of chimney gases 0·04 grain, the highest and lowest averages for any one work being 0·10 and 0·02 respectively.

Tar Works

In common with the last section, this also has suffered and from similar causes; a consequence noted is the increased yield of naphthalene from tar distillates, and of that obstructing gas mains. Few of the older and less efficient stills now remain; at two works these are being demolished to be replaced before next season by stills of improved modern design. There has been no complaint.

Efficiency in Power Supply for Chemical Industry

Notes on Plant Control Apparatus

The problem confronting every power plant engineer is that of obtaining from the plant under his control the utmost efficiency combined with the lowest operating costs, and as far as is possible the elimination of waste in other departments. Below are notes on some of the many types of apparatus which will aid the keeping of a reliable check both on input to the plant and on the load taken from it by various departments, and also act as a guide to the efficient working of the plant.

Power Plant Economy

WHEN an engineer decides to effect economy in his boiler house, he is confronted with the problem of obtaining instruments satisfactory for his requirements, and this at times is apt to prove a difficult problem. There are a large variety of instruments intended to assist in the production of cheap steam. Some instruments offered for the purpose of measuring steam, water, carbon dioxide, etc., are frequently of the kind beloved by the chemist and consist of numerous glass tubes with rubber connections; but whilst such apparatus may prove entirely satisfactory in a laboratory, it is of little assistance in the power plant, where the need is for some rugged type of instrument which will have the ability to remain in constant service, but which at the same time will require the minimum of attention.

In large generating stations an engineer is usually employed for the purpose of keeping in order the various instruments installed and checking them, so as to ensure that they are working to a reasonable degree of accuracy. The industrial boiler house rarely has a man for such a purpose, and therefore considerable attention has been paid during recent years to the study of the needs of the industrial user, and instruments are now available built so as to give, at all times, reasonable service combined with the minimum expense and maintenance. An instrument which is simple in design and stoutly constructed is the Bailey Meter, manufactured by Industrial Combustion Engineers, Ltd., of Wybert Street, London. A knowledge of power plant performance is essential before any economies can be effected, and the employment of steam flow meters for the purpose of ascertaining the amount of steam supplied to various departments in a factory is now becoming common practice. With a knowledge of the steam costs secured, steps can be taken to ascertain whether steam in excess of reasonable requirements is being consumed, and if this is the case, effective measures can be taken to reduce the amount supplied.

Having obtained steam costs is a step in the right direction, but it must be remembered that there is at least one other place in the works which can be a fruitful source of wastage, and that is the boiler house.

Many instruments have been devised to assist in promoting combustion efficiency; but frequently the design of these has been such as to necessitate their having constant attention. If neglected they go out of service, and after continued breakdowns, it is only natural that the boiler operators should lose faith in the instrument, with the result that little attention is paid to the results produced. It has been stated that to install a complete metering scheme for the boiler house is a very costly undertaking, but it can be shown that this is not so, and what expense is incurred is usually retrieved as the result of more efficient working within a reasonable period of time.

An instrument with many special features is the Bailey boiler meter, which records on one chart the steam flow from the boiler and the air supplied for combustion. The instrument is so arranged that when the two pens are coincident, it indicates that the boiler is steaming at maximum combustion efficiency.

The instructions to the boiler fireman are simple and the indications on the meter are such that they can be readily understood. It is interesting to note that the manufacturers of this instrument claim that the combination of steam and air flow on the one chart dispenses entirely with the need for any form of CO_2 apparatus. This alone should merit the attention of every engineer who is interested in boiler efficiency. Another advantage of the Bailey meter is that as many as four records may be made on the one chart, thus greatly facilitating the work of the responsible engineer, who can obtain the complete "story" of the boiler operation arranged in such a manner that the records are directly comparable.

Firing Control

In order that a power plant engineer may effect saving in cost of fuel and work his plant most efficiently he should know the calorific value of his fuel, its moisture content and something of the ash content, and should have the means of determining these values. Apparatus of this nature is to be found in the Roland Wild pattern solid fuel calorimeter, which is a product of Alexander Wright and Co., Ltd., of London.

It consists of a combustion chamber with screwed cap suspended from the cover by a stout tube furnished with a valve. The copper water vessel is surrounded by an outer casing heavily nickelled, the annular space between the two vessels forming an air jacket which prevents radiation and absorption. An agitating paddle manipulated from the outside is provided, and a sensitive Fahrenheit thermometer, the scale being divided into tenths of a degree.

The "firing" of this pattern is effected by hot wire, and the stirring paddle is worked by hand. In another pattern the firing is electrical and the stirring by spring motor.

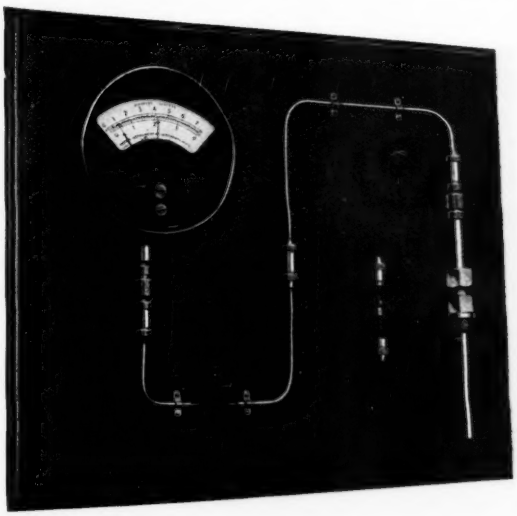
To obtain the maximum efficiency from his plant the stoker should have some visible indication of what is going forward in the furnaces, so that control may be exercised over the firing, the chief aids to such control being the draught gauges and CO_2 recorders. The S.A.W. patent CO_2 recorder, made by Wright's, is a simple form of recorder, and will record not only the per cent. of CO_2 in flue gases, but also the draught if desired. All fluid levels are self-adjusting.

The automatic adjustment of the liquid level makes this CO_2 recorder suitable for tropical countries and for positions in boiler-houses where there is much heat.

This firm also makes much apparatus of interest to the power gas user, and also pressure recorders, many forms of thermometers, and gas analysis apparatus.

The Foster Pyrometer

Although subject to certain brilliant and notable exceptions, it is remarkable that there has been a widespread neglect in connection with proper temperature measurement as applied



PYROMETER FOR SUPERHEATED STEAM (DIAGRAMMATIC).

to steam power plants. The responsibility for this neglect may be fairly divided between the instrument makers and the power plant engineers. The instrument makers in the past

expected the engineer to use pyrometric instruments which were not specially designed for the conditions and requirements of steam power plant. The engineer, while taking great pains with fuel analysis and other measurements, has largely left the temperature to take care of itself or, if he has installed temperature measuring apparatus, he has not always insisted upon the requisite care and upkeep being provided, with the result that the instruments fell into an inaccurate and neglected condition.

In view of the admitted economies and advantages which can be derived from accurate pyrometer control and the great improvements made in the instruments now available there is little excuse for this money-wasting neglect. Amongst the instrument makers who have specialised in instruments largely adapted for power plant service is the Foster Instrument Co., of Letchworth. The figure shown illustrates a diagrammatic assembly of a pyrometer, for instance, for superheated steam. Of course, the details of the installation vary largely with the particular power plant, but the parts shown illustrate the simplicity of the whole outfit. The simplicity of the apparatus is conducive to a much desired robustness.

Utilisation of Waste Heat

In many industrial processes, a large amount of heat is allowed to go to waste and this wastage is especially noticeable in steelworks, gasworks, and cement-making plants. For the purposes of utilising waste heat from cement kilns, the well-known Babcock and Wilcox high gas velocity boiler has been developed, and a large number are now in operation. The gases from cement kilns are liable to arrive at the boiler heavily laden with dust, but no great difficulty need occur when reasonable precautions are taken for thecleaning off of this dust.

The gases leave the kilns working on the dry process, at a temperature of 1,300° to 1,400° F., and it will be seen readily that if the gases are not put to some efficient method of utilisation there will be an economic loss, reducing the overall efficiency of the plant. The accompanying plate illustrates a typical plant consisting of boiler and economiser working under high gas velocity conditions with induced draught fans recuperating the waste heat from a rotary cement kiln. The output from the kiln over a measured period of six days was 1,049 metric tons and the temperature entering the boiler was 1,380° F. The steam supplied by this boiler was sufficient to give an average output from the turbo generator of 1,000 kw, and in addition it was estimated that the boiler supplied steam to the extent of 22,400 lb. per hour. Babcock and Wilcox are now building boilers in connection with cement kilns, having 12,000 sq. ft. heating surface, and the evaporation obtainable should be as much as 400 lb. of steam per barrel of cement produced.

It was feared at first that the interposition of a boiler would affect the output of the kiln, as was also expected in the case of steel furnaces, but the induced draught fans produce ample draught. These fans can be driven either electrically or by steam, and in the case of the latter the exhaust steam can be utilised for heating the feed water. Many had thought that the dust carried over from the kilns would have a deleterious effect on the boiler heating surface, would have a tendency to stick to the tubes, and also have a lowering effect on the output of the boiler, but in practice no difficulty has been experienced in keeping the boilers externally clean. The dust being light shows (in the case of the dry process) but little tendency to stick to the tubes, and can readily be removed.

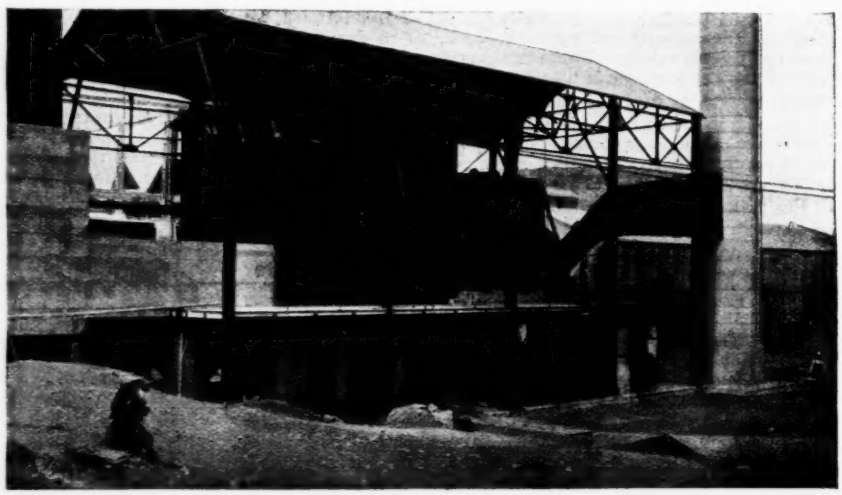
In dealing with the waste heat from cement kilns, it is important that air leakage should be reduced to a minimum. Care must be taken in checking leakage at the kiln mouth and special inspection doors throughout the boiler are always provided. Apart from cement plants, Babcock and Wilcox, Ltd., have also installed plants for utilising the waste heat from brick kilns and chemical furnaces such as those dealing with barium salts. In the latter, especially, the dust contents of the gases are very high, but by the use of calorised diamond soot blowers, no difficulty occurs in obtaining normal output from the boiler.

Temperature Registering and Recording

An extremely important point in boiler operation is the maintenance of temperature, and from this arises the necessity of installing indicating instruments which can be read easily from a distance and are, at the same time, sufficiently sensitive to be of use. The Budenberg Gauge Co., Ltd.'s Steel-tube mercury thermometers for registering temperatures up to 1,000° F. are made in two types—one with a rigid stem, and the other with a flexible tube lead, which is specially suitable for use with recording instruments which need to be kept away from the source of heat.

These instruments consist of a cylindrical steel vessel formed in the end of an insertion tube and communicating by means of a steel capillary tube with the spring tube of a steel-tube pressure gauge, the entire system being completely filled with mercury under pressure. If the mercury in the steel vessel is heated it will expand, with a resulting increase of pressure. A certain definite pressure corresponds to each temperature.

The Budenberg Columbia self-recording thermometers are supplied either with circular or oblong time chart, and are a useful means of keeping a record of temperatures under varying circumstances. Other instruments in the Budenberg range include boiler flue thermometers, vapour tension instruments (Ether Thalpotassimeters) for use in diffusing and heating apparatus, etc., and smaller instruments for general purposes.



RECUPERATING WASTE HEAT FROM ROTARY CEMENT KILN

Checking Steam Consumption

Although nowadays economical steam production has become a science in itself, in many cases a large amount of waste often occurs after the steam has left the boilers because there is no check on the steam used.

The use of a steam meter will do much to improve conditions, and in the case of works where the practice of selling steam to each department is followed a meter is indispensable.

In addition to effecting economy the use of such an instrument enables the firemen to tell if they can turn out more steam at any given moment. The Cook steam meter, made by Chas. W. Cook and Sons, of Ashby-de-la-Zouch, records on a chart, in pounds per hour, the quantity of steam passing through a pipe, without interfering with the flow, and at the same time compensates for any variation of pressure. The principle upon which the meter operates is that of the pitot tube. A plug screwed into the steam pipe contains two bent tubes, one pointing against and one with the flow of steam. The rush of steam past these tubes causes a slight increase in one and a corresponding decrease of pressure in the other.

This pressure difference is made to operate a spring-controlled diaphragm, the movements of which give a measure of the velocity of steam.

The meter contains no parts liable to be deranged and may be fitted without disturbing the pipe line.

In the Mahler-Cook bomb calorimeter special attention has been paid to the gas admission valve and the ignition plug, which are usually a source of trouble in apparatus of this description.

A Useful Steam Trap

A steam trap which is notable for its simplicity and the absence of moving parts is that produced by the Telechron Electric Transmitter Co., of London, the Newton Steam Trap.

There are two main portions, a solidly made cast iron tapered body, containing a tapered Monel metal plug. A number of labyrinth grooves on the plug form a secure packing against steam leakage but allow water to pass continuously. The adjustment of the tapered plug in the cast iron body is set by means of a cone screw, and needs no further adjustment after the trap is installed. For the one inch size trap the aperture formed between the plug and the body is sufficient to allow of 90 gallons of condense to pass per hour at the steam pressure of 120 lb. This trap also acts as a non-return valve, thus saving the extra cost of a separate valve when raising the condense to a hot water supply tank. All steam traps, we are informed, are tested to 600 lb. pressure before leaving the firm's London works.

Lubricators and Steam Power Accessories

In lubrication it is a good maxim to remember that an oil is a good lubricant only in so far as it is suited to its purpose, and the most satisfactory test is to buy oil of approved quality, after providing the maker with particulars of lubrication desired, and then giving the oil a good running trial. W. H. Willcox and Co., Ltd., of London, who have made a study of lubrication requirements, supply oils for a wide range of machinery, including steam cylinders, valves, steam turbines, crank chambers, air compressors, internal combustion engines, electrical and agricultural machinery. Other lubricating products include Willcox-Fiske greases. Besides the above-mentioned specialities this company also supply many accessories and components for power plant, such as ejectors, injectors, valves for many uses, belts, belt preservatives, and boiler cleaning apparatus.

Electrically Operated Meters

The "Electroflo" electrically operated flow meter, made by the Electroflo Meters Co., Ltd., is entirely free from mechanism and has but one moving part, an unrestricted mercury column utilised for interpreting changes of head.

The advantages of the "Electroflo" meter are manifold and of practical use. For example, the reading instruments may be located at the points where they are of greatest value, irrespective of the distance from the measuring point. This means that an operator can be provided with clearly visible guidance right at his control platform, whilst the recorders and totalisers operating in series therewith are suitably centralised for the use of the chief engineer, and assist his supervisory duties. This feature is of special value in boiler and industrial process control.

It is to be noted that the reading instruments function entirely independently, and an exclusive feature is continuous integration without dependence upon the recorder movement.

The "Electroflo" motor driven CO_2 recorder, which is fully described in a booklet entitled "CO_2 and Fuel Costs," has several special points of interest. The instrument functions on the fundamental principle of measurement by chemical analysis. It is completely free from glassware, fragile materials and rubber connections, and is independent of water supply, being electrically-driven with all of the driving mechanism completely immersed in oil. The instrument will function for five months in normal operation on one charge of caustic potash. The "Electroflo" motor-driven CO_2 recorder is a solution to what has been a somewhat vexed problem, and the instrument is remarkably robust, having none of the delicacies of laboratory instruments.

Feed Water Control

The "Thermofeed" feed water regulator, manufactured by Ronald Trist and Co., Ltd., 56, Victoria Street, S.W.1, fulfils two functions. Firstly, it automatically controls the water level in the boiler and thus obviates the attendance of a fireman constantly to regulate his check valves, so that he can spare far more time for other duties, thereby keeping the boiler plant in a more efficient condition. Secondly, the "Thermofeed" maintains the water level with a very high degree of accuracy, which produces a marked increase in boiler efficiency, the reason being that if the water level is allowed to rise considerably above the mean working level the fires must be forced in order to maintain a constant steam pressure, which is a direct waste of fuel. Immediately the water level falls below the mean level there is insufficient water in the boiler to absorb all the heat given off by the fires and the temperature of the flue gases therefore rises. In many casses the increase in efficiency due to fitting a "Thermofeed" has been as much as 6 or 8 per cent., depending on local conditions, and there has been a case which has gone up as high as 13·5 per cent. These regulators are made in several types suitable for pressures up to 350 lb. per square inch.

Another piece of apparatus for feed water control made by this firm is the Hilo water alarm, a simple and foolproof device which is fitted outside the boiler and gives warning by a whistle when the water in the boiler varies a certain distance on either side of the normal level.

The essential moving parts of the "Hilo" are the two open-topped buckets and a whistle control valve, these being connected by a simple lever action.

Air Cleaners for Petrol Engines

The Visco Engineering Co., Ltd., London, have for many years specialised in the various problems of air filtration, and the Visco air filter has been widely used for supplying dust free air to electrical machinery and air compressors. Recent researches in America and elsewhere have demonstrated that ordinary atmospheric air taken in by petrol engines requires cleaning if the best results are to be obtained. The company have therefore recently produced a series of air cleaners based upon the Visco air filter principle and suitable for all sizes of petrol engines, ranging from the smallest motor cycle engine to the largest lorry engine, and suitable also for air compressors.

These filters are described in the company's leaflet No. 272. They are constructed of metal throughout, are simple in design, as far as possible "foolproof" in operation, and require practically no attention beyond an occasional cleaning of the dirty filter cell.

Steam and Centrifugal Pumps

The Pulsometer steam pump made by the Pulsometer Engineering Co., Ltd., is a pump that has no moving parts except the valves, which are of an exceedingly simple type and can be readily replaced by unskilled labour. There being no frictional surfaces to cut out, the Pulsometer pump will pump dirty water with little wear and tear. There is no exhaust steam; the steam, having done its work in forcing the water out of the pump, is condensed, and the vacuum thus formed draws more water into the pump. The Pulsometer steam pump, being self-contained, requires no foundations, and can be slung on a chain. No lubrication or packing is required. The standard pattern is suitable for a 90 ft. vertical lift, and the special pattern is suitable for lifts up to 150 ft.

Caration Fire Bars

An increase of nearly 100 per cent. of air inlet is claimed for Caration fire bars by the makers, G. F. Evans and Co., of Replingham Road, London. The bars burn any kind of fuel, however small, and, it is stated, smoke is reduced, while clinkers do not fix to them. They can be fitted to any make of boiler, and existing bearers do not have to be altered to take them.

Chemical and Dyestuff Traders' Annual Meeting

Demand for Fuller Recognition

Vigorous criticism of the policy of the Government and of some of the departments was again offered at the annual meeting of the Chemical and Dyestuff Traders' Association. Both the retiring chairman (Mr. Victor Blagden) and the new chairman (Mr. F. T. T. Reynolds) discussed in plain terms the effect of large manufacturing combines on the interests of merchants and consumers.

THE fourth annual general meeting of the British Chemical and Dyestuff Traders' Association was held at the Great Eastern Hotel, London, on Friday, June 17. Mr. Victor Blagden presided.

Review of the Year

The CHAIRMAN, in presenting the accounts and reviewing the work of the year, emphasised the importance of an association to guard merchants' interests, and stated that the work done during the past year had had a salutary effect in official quarters. Referring to the renewal of the Key Industries Act, he described the inquiry proceedings as a sham, and said that their experience of the provision for exempting from duty products not produced in the Empire indicated that the Board of Trade were reluctant to give effect to it. This was shown in their action respecting oxalic acid, hydroquinone, cocaine hydrochloride, lactic acid, etc. During the year an attempt was made to add a further 1,000 chemicals to the list of dutiable products, but this was successfully resisted. With respect to the Merchandise Marks Act, the position reflected a total lack of appreciation of the conditions under which international trade was carried on; the Act was a tariff barrier in disguise. Manufacturers in this country were more likely to achieve the object in view by marking their own products with an indication that they were British made.

The Position of the Merchant

While the Government appeared to be doing their utmost to make it impossible for the merchant to continue in business as a distributor, they gave every facility to manufacturers to act as merchants. A fair percentage of the products sent out from makers' works connected with the fine chemical industry were not manufactured by those firms. At the most they were decanted. It was purely merchanting business carried on by firms calling themselves manufacturers. One of the most powerful chemical manufacturing interests in this country, who refused to do business with the independent merchant and who advocated the elimination of the merchant, did a tremendous amount of merchanting business themselves in products not of their own manufacture. It had for the past four years been one continual up-hill fight to maintain for the merchant trader in chemicals that position which his experience and hard work and enterprise had gained for him. He appealed to the Government and to their departments to give to merchants as a class the same amount of consideration and recognition that they gave to manufacturers.

Manufacturers' Combines

"This tendency," the Chairman continued, "on the part of the maker to do his business by direct contact with consumers rather than through merchanting firms has been accompanied in recent times by the formation of manufacturing groups controlling the markets in a number of chemical products. We are told that the object of the formation of these vast industrial rings and groups in many trades besides our own in this country is not to set up monopolies and international trusts, but to avoid overlapping and to reduce costs of production. Advocates of these octopus commercial undertakings have used the unconvincing arguments that consumers will benefit by obtaining their raw materials at lower prices and that the concentration of groups of individual manufacturing concerns working under one uniform direction is necessary in order to meet outside competition from countries where similar movements have been taking place. I venture to state that the amalgamation or co-operation of a number of industrial companies does not tend to lessen overhead expenses, rather, as we know from experience, do they become unwieldy and wasteful. Monopolies have only one object and that is to eliminate competition and set up and maintain high prices. We have recently had the case of the Southern Railway who, rather than accept the terms of a manufacturing ring in this country, placed their contract with a foreign manufacturer. In the chemical trade the position of the consumer may soon be even worse than this, for the recently formed chemical combine is now reported to be endeavouring to arrange an international trust with the big continental group. If that proposal materialises the consumer will be quickly made to realise his unhappy position.

"Under a free and competitive market the buyer has only himself to blame if he does not get the quality material best suited for his purpose at the most advantageous price. That is a buyer's right and it is those conditions of free and competitive sources of supply that guarantee him against having to accept material of unsuitable quality and at exorbitant prices. It must not be forgotten that it is the independent merchant who provides and maintains a competitive market. The number of products in the chemical trade in which the consumer has little or no choice of source of supply is already considerable, and I think it will be found that without exception consuming industries are now paying more for these products and are getting far less satisfactory facilities than they obtained on an open market through the merchant.

"To-day it seems that the chief aim of the manufacturers is not to produce an article second to none in quality and at a fair price, but to bring about conditions that will guarantee to him the sale of his products whether they be satisfactory or not and at a price that will allow for the use of methods that are far from economical and up-to-date but at the same time highly remunerative."

The New Chairman's Views

On his election to succeed Mr. Blagden as chairman, Mr. F. T. T. REYNOLDS (Millwards Merchandise, Ltd.) said that there was greater need than ever for sustained activity in the general and collective interests of their trades. With the growing tendency to form big combinations of concerns already large individually and the delegation, wittingly or unwittingly, by the House of Commons of more and more power to the Board of Trade, and the further delegation of such power to permanent officials, importers and merchants, particularly in chemicals and dyestuffs, were in serious danger of being crushed out of existence between the upper and the nether millstones. The merging of interests, national and international, meant almost inevitably that the combines would do their utmost to act as far as possible with their own distributing departments until possibly sooner or later they discovered that it might be much less costly and much more effective to employ existing experienced channels of distribution formed by the merchant by many years of enterprise and hard work. Overseas trading, the continuance of which was of absolutely vital importance, had hitherto been largely built up and maintained by the merchanting and shipping interests. It was surely up to them as traders to maintain their collective organisation and to encourage and stimulate traders generally to organise and act collectively.

Merchants' Right to Recognition

With regard to the Board of Trade, it was common knowledge that in relation to chemicals and dyestuffs, consideration and assistance were freely given to most of the other interests affected, but that unfortunately, and for reasons difficult to ascertain and even more difficult to understand, importers and merchants were looked upon as a more or less unnecessary factor and as a negligible quantity. They were, therefore, either ignored or harassed rather than, as ought to be the case, recognised and assisted. The Dyestuffs Act was a notable example of the total exclusion of the merchant interest from proper consideration. Neither on the Dyestuffs Advisory Licensing Committee nor on any of the Departmental Committees had the authorities recognised that the experienced agents and importers of highly technical products might be of great assistance. A large proportion of the many mistakes might have been and ought to have been avoided. The same policy continued in the empanelling of committees under the Safeguarding of Industries Act.

"One of the aims of our Association," Mr. Reynolds stated, "must be to redress this long outstanding grievance and injustice. It is an old established economic principle that there shall be no taxation without representation. Why should this right cease to pertain to merchants and importers in the chemical and dyestuffs trades? The aftermath of the war is proving unexpectedly trying and prolonged, and traders are learning by bitter practical experience that the aggregation in this country of taxation, local rates, service and transport charges, etc., is enabling other countries, who are not so handicapped, to profit at our expense. We are losing large volumes of overseas trading, and the Board of Trade and the Treasury fail to see and understand that the trade of the country generally and of the textile trades particularly is in the throes of almost unexampled depression. If the powers that be are wise, they will apply themselves to rigorous economies all round, and cease to harass trade, and stop the imposition of trade barriers, but rather gradually have such barriers removed. It should be made more evident that the Board of Trade exists to help and not to hinder trade, and that the Treasury must reduce taxation before the burden breaks the back of the taxpayer.

"In the meantime, whilst making it clear that we are always prepared to give a preference to British made products, we have a perfect right to perform the patriotic duty of assisting the British consumer to procure his essential requirements at the most advantageous possible price and quality. Otherwise his competitors abroad will continue to capture his trade in finished textile and other products to the serious detriment of our national interests. Notwithstanding the formidable obstacles with which we are beset, if we persistently pull together we shall, when the trade of the country revives, participate in the advantage, as the trade in chemicals and dyestuffs still remains a barometer."

Election of Officers

Mr. Victor Blagden, who retired from the chair, was elected president of the Association; the vice-chairman (Mr. F. T. T. Reynolds) was elected to succeed him in the chair; Mr. A. F. Butler (treasurer) was elected vice-chairman; Messrs. A. Hughes and S. J. C. Mason were elected auditors; and Messrs. Chas. Page, J. G. Gordon, and J. M. Hurst were re-elected to the executive committee.

Oils, Chemicals, and Colours

Exhibition to be Held Next Year

A LARGE and thoroughly representative meeting of the exhibitors (47 of whom signed the attendance book) of the recent International Oil, Chemical and Colour Trades Exhibition was held at the Royal Agricultural Hall, London, on Friday, June 17, at the request of the organisers, who invited expressions of their opinion on the Exhibition, and any criticisms they might have to offer regarding the conduct and success of the enterprise. They were also asked to decide whether, in their opinion, it was advisable to repeat the Exhibition, and if so at what date.

The speeches were eulogistic as regards the success of the Exhibition, and it was unanimously decided that the Exhibition should be repeated in the Spring of 1929.

The following from those present were elected by the exhibitors to serve as an honorary advisory committee for the next Exhibition:—Mr. S. J. C. Mason (Bush, Beach and Gent), Mr. F. Burrell (J. W. and T. A. Smith, Ltd.), Major J. H. Foster (Joseph Foster and Sons), Mr. J. R. Torrance (Torrance and Sons), Mr. W. Gundry (Morris Ashby, Ltd.), Mr. S. W. Whiffen (Whiffen and Sons), Mr. Leonard H. Hill (*Chemical Engineering Catalogue*), Col. A. E. G. MacCallum (Sidney Smith and Blyth, Ltd.), Mr. F. Gunn (W. T. Nicholson and Clipper), Mr. F. J. Ryland (M. Lummerzheim et Cie), and Mr. K. L. Cobb (Building and Metal Export Co.). The hope was expressed that a representative from Howards and Sons, Ltd., would join.

Other matters, such as publicity, opening and closing hours, and the strengthening of certain sections of the Exhibition were discussed, but it was generally agreed that, as the Committee that had been elected was very representative of the trades embraced by the Exhibition, such matters could safely be left in their hands.

The Organisation of Chemists

To the Editor of THE CHEMICAL AGE.

SIR,—The National Organiser of the National Union of Drug and Chemical Workers and the General Secretary of this Association are discussing two different things. This you have yourself noted since the Union's letters carry the title the "Organisation of Chemical Industry," those of the Association that of the "Organisation of Chemistry."

The nominations committee of this Association has no status in the industry and desires none; it is sufficient that they should obtain a status in the profession. The Association knows better than to concern itself with the organisation of chemical industry when another society better qualified to deal with it, I mean the Society of Chemical Industry, exists for that purpose. No public authority and no employer formally accepts the B. qualification as a criterion of qualification since the matter is a professional and not an industrial question. Public bodies and employers do not, in fact, recognise the status of any particular qualification; they select, from this qualification or that, that which meets their need.

For the benefit of your correspondent it seems necessary to repeat that first of all the British Association of Chemists is concerned with the establishment of a qualification which shall form the basis of a register to be legally recognised. With legal recognition will come the time to discuss the question of status with public bodies and in industry.

In regard to the matter of a joint council, such a body as Mr. Wilson Coates suggests cannot deal with "a charter for the grading qualification and registration of chemists." It need not be doubted that the process worker, the retailer, and the labourer will be found capable of holding their own upon a council, but they are not qualified to discuss matters which affect the profession of chemistry as distinct from chemical industry, and no useful purpose can be served by inviting them to do so.

Without desiring or intending any discourtesy to the Union, we do not hold that they can appropriately discuss purely professional questions any more than this Association could create machinery to organise chemical industry, though it is always prepared to co-operate with other societies where it is able to assist in discussion or action.—I am, etc.

H. T. F. RHODES,
General Secretary,
British Association of Chemists

175, Piccadilly,
London, W.1.

Fire at B.D.C. Works

Supposed Origin in Tar-Still

THERE was an outbreak of fire early on Saturday, June 18 at the Huddersfield works of the British Dyestuffs Corporation, in an extensive brick-built shed which contained large quantities of naphthalene, beta-naphthol, caustic soda, and soda ash. The contents were soon blazing fiercely. The works fire brigade did what they could to subdue the fire, but when the Huddersfield brigade reached the works they found that a portion of the roof of the shed had already collapsed. When the fire was at its height the flames could be seen for miles around.

In their work of extinguishing the outbreak the Huddersfield brigade were handicapped by a number of small explosions caused by the gases from the escaping liquid, and at one time streams of flame were spreading in many directions. Fortunately, there was a plentiful supply of water, and the firemen were able to attack the fire from both ends and both sides of the shed. From ten jets an enormous volume of water was poured into the burning shed, and the danger of adjoining parts of the works becoming involved was quickly overcome.

The damage, which is estimated at several thousands of pounds, was to the roof, the plant, and the material. It is thought that the fire originated from one of the stills where the employees were blowing tar. The tar burst into flames, and the fire spread with such rapidity that the men were compelled to leave the machine at once and rush out of the shed. One of them had a very narrow escape from being badly burned. This department of the firm, it is stated, was very busy at the time.

Old London Tours

A LARGE number of guests assembled in the Publications Hall of Bouverie House, Fleet Street, London, the offices of Benn Brothers, Ltd., publishers of THE CHEMICAL AGE and associated journals, on Tuesday, for the first of the series of tours, which are being arranged for subscribers and friends, to places of historic interest in old London under the guidance of Mr. Allen S. Walker, a well-known authority on London antiquities.

The guests were welcomed by the chairman of the company (Sir Ernest J. P. Benn, Bt.), who said that the firm was proud of London and that there was too little effort made to get to know it, to study it, and to revel in it. Mr. Walker had devoted himself in a wonderful way to the study and exposition of the treasures of art and history to be found in England, and it had seemed to the board of Benn Brothers right and proper that, the company being installed in its new home in Fleet Street, it should invite its friends to share some of its interests in city life.

The party, on leaving the building, crossed Fleet Street and stopped for a moment while the lecturer pointed out the

IN THE TEMPLE PRECINCTS.

austere modern beauty of the office building, from which they were going to see the antique loveliness of the Temple. Passing along Fleet Street the party entered the Temple, first visiting the Temple Church, which, said Mr. Walker, was one of the most architecturally satisfying in London. Leaving the church the visitors were shown the quiet seclusion of some of the courts of the Temple, and passed into the Hall of the Inner Temple. After leaving the Temple Gardens, where Shakespeare laid the scene of the plucking of the red and white roses, a move was made to No. 3, Crown Office Row, the reputed birthplace of Charles Lamb, and to No. 2, Brick Court, where Oliver Goldsmith died. A magnificent view of the Middle Temple Library was seen from the plane-tree covered Fountain Court. After enjoying the dignified beauty of the Middle Temple Hall with its superb Elizabethan screen, the guests were privileged to see the Parliament Chamber of the Benchers of the Middle Temple. A return was then made to Bouverie House where tea was served in the staff canteen.

The next tour will be on Wednesday of next week, when a visit will be made to the Church of St. Clement Danes, a twelfth century building at No. 17, Fleet Street, and Dr. Johnson's house in Gough Square. There are vacancies for this tour still open, and places will be reserved for any readers of THE CHEMICAL AGE who care to send in their names.

Midland Dyestuffs Agent's Death

BY the death of Mr. William Taylor which occurred at Leicester on June 7, the colour and chemical trade of the Midlands loses one of its best known and most respected members. Associated with the well-known firm, the Ellis Chemical Co., Ltd., for many years (being, in fact, directly responsible for its inception), representative for Levinstein, Ltd., before the amalgamation of that firm with British Dyes, and latterly agent for the British Dyestuffs Corporation for Leicester and the district, Mr. Taylor's activities covered a very wide field. His keen business ability, combined with a very genial disposition and unfailing courtesy, secured for him a very large circle of friends, by whom his loss will be very keenly felt.

Investigations on Coal Hydrogenation

Work at Birmingham University

AN interesting report on recent work done at the Mining Research Laboratory of the University of Birmingham has just been issued by the executive board, under the signature of the chairman, Professor J. S. Haldane, F.R.S. An investigation of the conversion of coal into oil by hydrogenation was commenced in 1923 for the purpose of ascertaining how far the Bergius method of treatment with high pressure hydrogen at a temperature in the neighbourhood of 400° C. was applicable to English coals, and to obtain information on the reactions involved.

Various specimens of coal of different degrees of coalification have been tested, with valuable results. Comparative tests have been carried out in the pressure autoclave, using nitrogen in place of hydrogen, and also by carbonisation under atmospherical pressure. These experiments, carried out by Mr. D. G. Skinner, had shown that carbonaceous material which yielded a large amount of tar and oil by carbonisation at low temperatures did not necessarily give a correspondingly higher yield by hydrogenation. A true boghead or torbanite showed no appreciably increased yield of oil on hydrogenation, as compared with distillation, while that from a bituminous coal cannel was very much greater.

Successful Application Still Uncertain

The successful commercial application of the Bergius process is not yet assured, continues the report, and the board believe it cannot be until more is known about the nature and value of the products resulting from the treatment of coal with high pressure hydrogen. The investigations they are carrying out will, they believe, prove to be of very real economical value in the long run, though possibly not in the same directions as those covered by the Bergius patents. Increased financial support has been forthcoming from the British Colliery Owners' Research Association, and the programme has been extended. It has been found that certain types of coal are more suitable for hydrogenation than others. The question as to how far fuel in the solid state, and particularly coal, is likely to be displaced in the future by liquid fuel, whether derived from coal or obtained naturally, depends to a large extent on the relative thermal efficiencies obtainable with different varieties of heat engines and internal combustion engines. The Director has been devoting much of his attention to this subject, and has now nearly completed a book in which the current assumption that an internal combustion engine with oil as its fuel has necessarily a higher maximum thermal efficiency than a steam engine with solid coal as fuel is examined and rejected.

The need for further accommodation for the mining research laboratory has become pressing. A building given almost treble the space for laboratory, workshop, storage, secretarial, and other accommodation could be erected and equipped for £4,000. It is believed that various colliery owners throughout the country will be willing to contribute to a fund for a new building, which might be looked upon as the coal owners' research laboratory, especially for investigations on the physiological, chemical, and physical side of mining.

The researches mentioned above were rendered possible by financial support from the British Colliery Owners' Research Association, whose grant of £2,500 covered the general administrative expenses of the laboratory, and of researches on hydrogenation and other subjects. Thanks are expressed to the association for their recent decision to increase their grant to £3,000 per annum for three years from April 1 last.

Tar and Pitch Merchant's Affairs

THE creditors of Hugh Hosey, tar and pitch merchant, trading as H. Hosey and Co., of 88/90, Norfolk Street, Liverpool, were called together recently, at the offices of Mr. C. Semper, Liverpool, when a statement of affairs was presented which showed liabilities of £1,549 12s. 1d., of which £1,094 12s. 11d. was due to the trade and £454 19s. 2d. to the bank. The latter held collateral security. The assets were estimated to realise £275 5s. 1d., from which had to be deducted £78 3s. 7d. for preferential claims, leaving net assets of £197 1s. 6d., or a deficiency of £1,352 10s. 7d. An offer was made of a composition of 4s. in the £, payable as to 2s. in July, 1s. in October, and 1s. on January 15, 1928, the last two instalments to be secured. A resolution was passed agreeing to accept the offer.

Standards for Insulating Oils

THE British Engineering Standards Association announce the issue of a new specification (No. 148, 1927) for insulating oils for electrical purposes (excluding cables). This specification is a revision of No. 148, 1923, which was a tentative specification for oils for use in transformers, oil switches, and circuit-breakers. The latter has been very extensively used, and as the result of over three years' experience in working with it various amendments have been found desirable, these being chiefly directed towards increasing the available sources of supply of suitable oils and also towards extending the scope of the specification to cover oils for all electrical insulating purposes with the exception of oils for use in cables. The classification of the oils in the new specification is based, as in the old specification, on the sludging properties of the oils, but Class C oil has been eliminated. Each class of oil is further subdivided, for classification purposes, into three grades, these grades being based on the "cold test" of the oils. The oils are no longer graded according to viscosity, only one viscosity limit being given in the new specification for all classes.

The methods of carrying out the various tests called for by the specification are very fully described in the appendices, the test for determining the sludge value of the oil having received special attention. Since the issue of the tentative specification in 1923 a considerable amount of research work has been carried out in connection with the tests on oils, and the experience gained in this work has been reflected in the descriptions of the methods of carrying out the tests. The preparation of this revised specification has been undertaken with full knowledge of the progress of the deliberations of the International Electrotechnical Commission, which is carrying out extensive tests with a view to the ultimate preparation of an international specification for tests on insulating oils.

Copies of the new specification may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria Street, London (2s. 2d. post free).

Fuel Utilisation, Ltd.: Erection of Plant

RESEARCH and experimental work is to be carried out at Richmond, Surrey, by the newly-formed company, Fuel Utilisation, Ltd., which is an offshoot of the Gas Light and Coke Co. Under the Trade Facilities Act the Government will contribute £100,000, and the nation's interest, in the event of the experiments proving successful, is safeguarded. Mr. R. W. Foot, assistant general manager of the Gas Light and Coke Co., states that Fuel Utilisation, Ltd., will proceed at once with the erection at Richmond of plant for the production from coal of smokeless fuel, motor spirit, and other oils, on a commercial scale, by means of the low temperature carbonisation process. He said that it was hoped to have the plant, which had been designed by the Fuel Research Department after an exhaustive investigation, in operation at the end of the year. To provide working data it is intended to operate the plant intensively for about three years unless, of course, complete success is achieved in a shorter period. At the end of the three years period the results will be reviewed and the works extended or closed down altogether.

Sir Frank Baines and I.C.I.

IN the House of Commons, on Wednesday, Captain Hacking (Under-Secretary, Home Office) announced the coming retirement of Sir Frank Baines, Director of Works, of His Majesty's Office of Works. Sir Frank has had charge of the Royal Palaces, the Houses of Parliament, and public historic buildings. He is to become consultant on architectural and constructional work for Imperial Chemical Industries, Ltd. The announcement was made in answer to a question on the subject of civil servants in the Office of Works undertaking private work, and Captain Hacking stated that the work undertaken by Sir F. Baines for Imperial Chemical Industries, Ltd., had proved to be on a more extensive scale than was originally understood. No reflection rested on Sir F. Baines, who had acted in good faith after reporting the matter to the proper quarter. But as Sir Frank was unable to withdraw from his undertaking to the company, he was retiring on pension from the service on or about September 1 next.

Chemical Matters in Parliament

Sugar Beet Cultivation

The amount of subsidy paid to companies producing beet sugar in Scotland, in respect of the 1926 crop, was £71,421 8s. 5d., stated Sir J. Gilmour in reply to a question by Mr. Stephen (House of Commons, June 21). Under the British Sugar Subsidy Act no subsidy was paid direct to growers. The area under crop in 1926 was 3,649 acres; it was estimated that there would be 12,500 acres under crop in 1927. The total output for Scotland from the 1926 crop was 71,971½ cwt. of sugar and 16,705½ cwt. of molasses. The Government had assisted two factories in Scotland by way of guarantees under the Trade Facilities Act. A guarantee of £180,000 had been given to the Orchard Sugar Co., Ltd., in respect of the Greenock factory, and a guarantee of £865,000 to the Second Anglo-Scottish Beet Sugar Corporation, of which approximately £250,000 was allocated to the cost of the Cupar factory.

Sale of Government Shares in British Celanese

Mr. McNeill (Financial Secretary, Treasury), replying to Mr. W. Thorne (House of Commons, June 22), said that as had frequently been explained, the Government in 1920 took 1,450,000 7½ per cent. cumulative participating preference shares of £1 of British Celanese, Ltd., as payment for the war indebtedness of the company on debenture and mortgage. Seven hundred and fifty thousand of those shares were surrendered in 1922 on a reconstruction to obviate liquidation, and 200,000 were sold later in the same year at 7s. The balance of 500,000 shares was placed in 1923 in the hands of trustees for realisation, and had recently been sold at 20s. net. His Majesty's Government's participation in the affairs of the company would consequently cease.

"C.A." Queries

We receive so many inquiries from readers as to technical, industrial, and other points, that we have decided to make a selection for publication. In cases where the answers are of general interest, they will be published; in others, the answers will simply be passed on to the inquirers. Readers are invited to supply information on the subjects of the queries:—

57 (*Stearic Acid*).—"We should be obliged if you would let us have a list of the manufacturers and dealers of stearic acid in the United Kingdom."

58 (*Grease Compounding*).—"Can you give us any practical information with regard to grease compounding (anti-friction and cap grease specially)?"

59 (*Calcium Silicide*).—A London firm is anxious to get in touch with manufacturers or suppliers of calcium silicide.

60 (*Molybdenite*).—"Can you give us the names and addresses of suppliers of molybdenite?"

61. (*Solvent for Solidified Linseed Oil*).—"Could you tell us the correct solvent for solidified linseed oil?"

Uses of Mica

THE chief use of mica is in the electrical industries, states the United States Bureau of Mines, Department of Commerce. One very widespread and important use is in the manufacture of the transmitter button, an integral part of the modern telephone instrument. Mica is also used in the manufacture of lightning arresters, condensers, commutators, and many special types of equipment. In addition to its use for the glazing of stoves and furnaces, mica is manufactured into lamp chimneys, particularly for gas and gasoline lamps. For this purpose the mica must be clear, even splitting, and flexible; little domestic (American) mica is suitable for this purpose. Ground mica is utilised in the preparation of rolled roofing; it is dusted on the roofing material before rolling, and thereby prevents sticking of the rolls. A pound of mica has great covering power, because of the flat shape of the thin particles. Ground mica is also used as a decorative material on wall-paper and in special paints. It is occasionally employed as a facing for concrete to simulate granite. Coarsely-ground material is used for decoration.

From Week to Week

FATAL INDUSTRIAL ACCIDENTS reported during May included 8 in chemical, etc., factories.

THREE MEN WERE INJURED in an accident when a slag ball burst while they were breaking it up at the Tarmac Works, Jarrow, last week.

A FIRE BROKE OUT on Saturday at the Soho Works, Smethwick, of W. and T. Avery, Ltd., in the paint and decorating shops. Half the department was saved.

THE YORKSHIRE DYEWARE AND CHEMICAL CO., LTD., have subscribed £10 to the Leeds local executive committee's appeal for £5,000 in connection with the forthcoming visit of the British Association for the Advancement of Science.

IT IS REPORTED that negotiations concerning prices and sales are in progress between the Standard Oil Co. and the I.G. Farbenindustrie, in connection with the commencement of production of synthetic oil by the latter company.

THE PRODUCTION OF INDUSTRIAL ALCOHOL (for use in motor-fuel mixtures) as a by-product in the manufacture of sulphate pulp for newsprint is being investigated by Canadian chemists.

AN INQUEST WAS HELD at Birmingham on Wednesday on Thomas Pugh, a platelayer in the employ of the British Cyanide Co., Oldbury, who was crushed by a girder weighing two tons during the repairs to a weighbridge last Saturday. A verdict of "Accidental death" was returned.

SCOTTISH ARTIFICIAL SILKS, LTD., artificial silk spinners and manufacturers, opened subscription lists on Monday, at par, for 500,000 preferred ordinary shares of 5s. and 500,000 deferred shares of 1s. There have been previously issued 260,000 preferred ordinary shares and 700,000 deferred shares. The present issue therefore completes the capital of £250,000.

MR. W. C. MITCHELL, M.I.C.E., M.I.M.E., M.I.P.T., has been appointed manager of the National Oil Refineries, Ltd., Llandarcy, near Swansea, in succession to the late Mr. A. M. O'Brien. Mr. Mitchell has been connected with the Anglo-Persian Oil Co. for many years, and until quite recently was at the head office, London. During the war he was chief experimental officer in charge of the R.A.F. Experimental Station at Orfordness, Suffolk.

MR. G. A. JULIUS, chairman of the Australian Commonwealth Council of Scientific and Industrial Research, has arrived in London from Australia. He is visiting England primarily to effect a closer liaison between the Commonwealth Council of Scientific and Industrial Research and the various scientific departments of the British Government. Mr. Julius will be the chief Australian representative at the Imperial agricultural conference to be held in London in October.

UNEMPLOYED INSURED PERSONS in the chemical manufacturing industry in Great Britain at May 23 numbered 5,857; in the explosives industry, 1,452; in the paint, varnish, japan, red and white lead industries, 748; and in the oil, grease, glue, soap, ink, match, etc., industries, 5,277. The percentages of workers unemployed were 6·2, 7·8, 4·3 and 6·6 respectively. As regards total unemployed in Great Britain and Northern Ireland, the percentages unemployed at May 23, 1927, were less by 5·8, 15·6, 2·5 and 4·7 respectively than at May 24, 1926.

APPLICATIONS ARE INVITED FOR the following appointments:—Assistant to the Public Analyst of the Metropolitan Borough of Stepney. The Town Clerk, Municipal Offices, Raine Street, London, E.1. July 4.—An Assistant Professor of Metallurgy in the University College of Swansea. The Registrar. July 2.—A Biochemist for the East Malling Research Station, near Maidstone, Kent. The Secretary. June 30.—A Chemical Laboratory Steward and Lecture Assistant in the University of Durham. The Head of the Department of Science, South Road, Durham. July 2.—A Temporary Junior Assistant Metallurgist for the Directorate of Metallurgical Research, Research Department, Woolwich. The Chief Superintendent, Research Department, Woolwich, London, S.E.18.

THE AMERICAN CELANESE CORPORATION is proposing to increase its capital by the issue of 250,000 prior preferred shares of $100 par value. 120,000 new split common shares of no par value are also to be issued at £10. The total capital increase will therefore be £6,200,000. It is understood that the whole of this sum will be devoted to extensive increases in the company's plant for manufacturing celanese yarn and fabrics, and that as a result production will not only be doubled, as already forecast, but even trebled and quadrupled. It is thought that there will be closer relationships between the American Celanese Corporation and British Celanese, though this does not necessarily mean that both concerns will work alike, since problems of manufacture and salesmanship are widely different in the two countries. The combined capital of the three organisations—American, British, and Canadian—exploiting the patents of the Dreyfus Brothers now amounts to nearly thirty million sterling.

MR. G. HEPBURN, B.Sc., has been elected special lecturer in chemical technology in the University of Manchester.

DR. LEONARD JAMES SPENCER, F.R.S., has been appointed a Deputy Keeper in the Department of Mineralogy at the British Museum.

EXPORTS OF INDIGO FROM INDIA in April amounted to 79 cwt., as compared with 129 cwt. in April, 1926; 4 cwt. went to Persia and Mesopotomia, 5 cwt. to Egypt, and 70 cwt. to other countries.

A LECTURE on "The Photosynthesis of Naturally Occurring Compounds," was delivered by Professor E. C. C. Baly, F.R.S., to the Bedson Club, at Armstrong College, Newcastle, on June 17.

THE ANGELA NITRATE CO., LTD., of 50, Lime Street, E.C., have changed their address to Finsbury House, Blomfield Street, E.C. The telephone number is London Wall 3177 and the telegraphic address "Angelology, Phone, London."

THE PH.D. DEGREE of the University of Glasgow has been conferred upon Mr. R. Hunter, for a thesis on "Studies in Thiolcamphor and in Narcotine"; and on Mr. P. Maitland, for a thesis on "A Study in Carbazole, Diphenylamine and Fluorene."

AT THE ANNUAL MEETING of the Bleacher's Association on June 17 it was stated that the cost of coal during the coal stoppage had amounted to £230,000 above contract price, and in addition the association had lost another £200,000 due to shortage of cloth.

RECENT WILLS INCLUDE:—Mr. W. E. Aykroyd, of Guiseley, a former Mayor of Bradford, late head of W. Aykroyd and Sons, Ltd., dyers and finishers, of Bradford, now a branch of the Bradford Dyers Association, Ltd., £104,768 (net personalty, £99,897).—Mr. Francis Spence, of Leeds, dyer, £19,621.

SUGAR BEET NEWS.—On behalf of the Anglo-Dutch group of beet sugar factory companies, Mr. Alfred Wood announced last week that a site had been secured near Bridgewater for the erection of a sugar beet factory, and it was hoped that it would be ready for the reception of the 1928 crop. The question of a factory in the south of England is also under consideration.

TEN MILLION LB. of ammonium sulphate per annum will be included in the annual by-product production of the new coke and gas plant which the Montreal Coke and Manufacturing Co. is constructing. Other products will be 350,000 tons of coke, 6,500 million cubic feet of gas, and 3,500,000 gallons of tar. The new company, which is now offering bonds to the public, has also leased and will operate the Montreal Light, Heat and Power Co.'s gas plant.

THE EXTENSIVE NEW PHOTOGRAPHIC FILM manufacturing establishment of the Glanzfilm Co. in Berlin has been acquired by Kodak Ltd., of London. The Glanzstoff Co., who owned the plant, are stated to be retiring from film manufacture owing to a decision to restrict their activities solely to artificial silk. The Kodak Co. now possesses plants outside the United States in England, Canada, Australia, France, and Germany.

THE ROYAL TECHNICAL COLLEGE, GLASGOW, announces that an arrangement has been made by which the School of Pharmacy, as from September, 1927, will be added to the list of institutions recognised for the purpose of phamaceutical chemists' qualifying examination, and to the list of institutions recognised as competent to grant the certificates required from the candidates at the B.Pharm. degree examination of the University of London for external students.

SIR ALFRED MOND gave evidence before the Railway and Canal Commission on Tuesday in support of the proposed amalgamation of a group of anthracite coalfields of South Wales, including the Amalgamated Anthracite Collieries, Ltd., and the United Anthracite Collieries, Ltd. He expressed the opinion that the proposed amalgamation would lead to a higher standard of efficiency, regularity of employment and economy. The future of the anthracite coal industry would require larger organisation from a national, indeed international, point of view.

PLEADING GUILTY to a charge of attempting to obtain money by false pretences from the British Drug Houses, Ltd., Alfred King, a counter hand, of Walthamstow, and Henry Richard Jarvis, of Walworth, were remanded at Old Street police court on June 13. A detective said the prosecutors dealt with a company in which Jarvis was a partner. In consequence of shortages of kegs in the warehouse a check was kept, and it was found there was a shortage on three dates. Witness saw Jarvis that morning, when he was presenting three accounts for payment, and told him he had reason to believe that he was invoicing for a larger number of kegs than had been delivered, and defendant admitted the fact.

SIR DAVID MILNE-WATSON will preside over the ninth annual conference of the Association for Education in Industry and Commerce, which is being held at the Kensington showrooms of the Gas Light and Coke Co. from June 28 to 30. Great engineering, textile and distributive firms, members of the Association, will be represented. Young apprentices, the sons of mechanics, are in some cases working their way up to the universities by means of firms' educational schemes, and the ladder of opportunity is having the effect of bringing public school boys into factories. The members of the Association look on this education of the worker not as philanthropy, but as a rightful charge on industry.

References to Current Literature

British

ANALYSIS.—A new and sensitive test for nitrates applicable in the presence of nitrites. A. H. Ware. *Analyst*, June, pp. 332–334.

DYESTUFFS.—The testing of dyestuffs for fastness to washing. S. R. Trotman. *J. Soc. Dyers and Col.*, June, p. 192.

The behaviour of oxides of lead towards dyestuffs. II. A. N. Adamson and J. K. Wood. *J. Soc. Dyers and Col.*, June, pp. 192–194.

GENERAL.—The production of fog in the neutralisation of alkali with hydrogen halides. H. O. Askew. *J. Chem. Soc.*, May, pp. 966–983.

A new type of primary cell. D. R. Barber. *Nature*, June 18, p. 892.

Trypanocidal action and chemical constitution. VI. Amphoteric *s*-carbamidoarylarsinic acids. H. King. *J. Chem. Soc.*, May, pp. 1049–1060.

The occurrence of indium in tin. J. R. Green. *Nature*, June 18, p. 893.

ORGANIC.—Arylamine salts of the naphthalenesulphonic acids. IV. Arylamine salts of Nevile and Winther's acid, acetylation of naphthionic acid and the arylamine salts of acetylnaphthionic acids. R. B. Forster and R. Watson. *J.S.C.I.*, June 17, pp. 224–226T.

The action of caustic alkali on the 3-halogeno-4-nitrosodimethylanilines. H. H. Hodgson and J. S. Wignall. *J. Chem. Soc.*, May, pp. 1144–1146.

A contribution to the chemistry of benzidine. H. H. Hodgson. *J. Soc. Dyers and Col.*, June, pp. 185–189.

PHASE RULE.—The system calcium ferrocyanide-sodium ferrocyanide-water. II. M. Farrow. *J. Chem. Soc.*, May, pp. 1153–1158.

RUBBER.—The oxidation of rubber. M. Leon and W. N. Lister. *J.S.C.I.*, June 17, pp. 220–224T.

United States

ANALYSIS.—Comparison of sensitivity of various tests for methanol. L. O. Wright. *Ind. Eng. Chem.*, June 1, pp. 750–752.

CEMENTS.—Some remarks on the colloidal theory of cements. T. Maeda. *J. Phys. Chem.*, June, pp. 933–936.

ELECTROCHEMISTRY.—An improved hydrogen electrode vessel and the electromotive force of the mercury, mercurous bromide, bromide ion electrode. R. H. Gerke and J. R. Geddes. *J. Phys. Chem.*, June, pp. 887–889.

Polarised platinum electrodes in neutralisation reactions. A. H. Wright and F. H. Gibson. *Ind. Eng. Chem.*, June 1, pp. 749–750.

GENERAL.—A contribution to the chemistry of edible domestic birds. J. S. Hepburn and A. B. Katz. *J. Franklin Inst.*, June, pp. 835–841.

The decomposition of ammonia on iron catalysts. C. H. Kunsman. *Science*, May 27, pp. 527–528.

The effect of gelatin on the size and distribution of macroscopic crystals grown from aqueous solutions. T. S. Eckert and W. G. France. *J. Phys. Chem.*, June, pp. 877–881.

OILS, ETC.—The distillation of petroleum for the manufacture of lubricating oils. W. F. Parish. *J. Franklin Inst.*, June, pp. 781–809.

The petroleum waxes. C. C. Buchler and G. D. Graves. *Ind. Eng. Chem.*, June 1, pp. 718–724.

PHYSICAL.—Ultraviolet absorption of spectra of cyclohexane, ethyl ether, methyl-normal-amyl and ethylene chlorohydrin. A. W. Smith, C. E. Boord, C. S. Adams, and C. S. Pease. *J. Amer. Chem. Soc.*, May, pp. 1335–1346.

Mutarotation. II. The relative velocities of mutarotation of α and β glucose: Effect of acid and salt. J. C. Andrews and F. P. Worley. *J. Phys. Chem.*, June, pp. 883–885.

German

ANALYSIS.—Methods of analysis of sodium nitrite. F. A. Hoeg. *Z. anal. Chem.*, Vol. 71 (3 and 4), pp. 102–107.

The determination of phenol and cresol. K. K. Järvinen. *Z. anal. Chem.*, Vol. 71 (3 and 4), pp. 108–117.

COLLOIDS.—The preparation of metal oxide-silicic acid sols from ignited metal oxide and silicic acid hydrosol. A. Fodor and A. Reifenberg. *Kolloid-Zeit.*, May, pp. 18–35.

The flocculation of hydrophobe sols by electrolyte mixtures. A. Rabinerson. *Kolloid-Zeit.*, May, pp. 50–58.

GENERAL.—On cresol-soap systems. I. Solubility in water of cresol-soap solutions. S. Jencic. *Kolloid-Zeit.*, May, pp. 69–79.

The toxicology of lead and its compounds. III. Lead-containing tooth-pastes. P. W. Dankwortt and G. Siebler. *Archiv der Pharm.*, May, pp. 424–426.

ORGANIC.—New and improved methods of synthesis of pharmacologically important amines. I. K. Kindler. *Archiv der Pharm.*, May, pp. 389–415.

Thioacetaldehyde. E. Müller. *J. prakt. Chem.*, May, Vol. 116 (1 and 2), pp. 175–191.

The action of Grignard solutions on aromatic thioketones. A. Schönberg. *Annalen*, May 14, pp. 37–46.

PHYSICAL.—The sorption of hydrogen by palladium precipitated on a carrier. T. Sabalitschka. *Archiv der Pharm.*, May, pp. 416–424.

A method of measuring small and partial vapour pressures. H. v. Halban and K. Siedentopf. *Z. angew. Chem.*, June 9, pp. 661–666.

Contributions to the hydrate problem. VI. Water transportation in solutions of organic electrolytes. H. Remy and H. Reisener. *Z. physik. Chem.*, April, Vol. 126 (3–4), pp. 161–172.

Miscellaneous

ANALYSIS.—Analysis of fuming sulphuric acid by thermometric titration. T. Somiya. *J. Soc. Chem. Ind. Jap.*, May, pp. 193–194B (in English).

Studies in improving estimation methods of impurities in crude camphor. I. Determination of content of water and solid matter. S. Yamada and T. Koshitaka. *J. Soc. Chem. Ind. Jap.*, May, p. 194B.

The arsenobenzenes: Methods of chemical analysis and determination. P. Breteau. *J. Pharm. et Chim.*, June 1, pp. 521–525.

The colorimetric determination of phosphates in potable water by the method of Denigès. R. Danet. *J. Pharm. et Chim.*, May 16, pp. 490–491.

Hyposulphite of soda: Its use as an indicator in alkalimetry. L. Daniel. *J. Pharm. et Chim.*, May 16, pp. 487–489.

OILS.—On the hydrocarbons in shark liver oils (Re-examination of the chemical formula of squalene). M. Tsujimoto and K. Kimura. *J. Soc. Chem. Ind. Jap.*, May, pp. 200–201B (in English).

The quality of fish oils observed from the standpoint of the hardened oil industry in Japan. Second Report. On sardine oil. S. Ueno and K. Yasuhara. *J. Soc. Chem. Ind. Jap.*, May, pp. 201–204B (in English).

ORGANIC.—Study of the action of sodamide on cyclohexanone. R. Cornubert. *Comptes Rend.*, May 23, pp. 1258–1259.

Trifluoroacetoacetic acid and ester. I. F. Swarts. Trifluoroacetoacetic ester. F. Swarts. *Bull Soc. Chim. Belg.*, April, pp. 313–322, 323–345.

β-Pyridyl α-pyrollidine (nor-nicotine). M. and M. Polonovski. *Comptes Rend.*, May 30, pp. 1333–1335.

PHYSICAL.—The viscosity of liquids above their boiling points. I. T. Titani. *Bull. Chem. Soc. Jap.*, April, pp. 95–105 (in English).

The density and index of refraction of solutions. G. de Lattre. *J. Chim. Phys.*, May 25, pp. 289–308.

Measurements of the heat of combustion of calcium cyanamide and calculation of heat of formation therefrom. N. Kameyama and S. Oka. *J. Soc. Chem. Ind. Jap.*, May, pp. 191–193B (in English).

Dissociation pressure of sodium sulphate decahydrate. II. M. Matsui, S. Fukushima, and S. Nakata. *J. Soc. Chem. Ind. Jap.*, May, pp. 198–200B (in English).

Patent Literature

The following information is prepared from published Patent Specifications and from the Illustrated Official Journal (Patents) by permission of the Controller to H.M. Stationery Office. Printed copies of full Patent Specifications accepted may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at 1s. each.

Abstracts of Complete Specifications

270,809. ACETIC ANHYDRIDE, PURIFICATION OF. British Celanese, Ltd., 8, Waterloo Place, London, and W. P. Skertchly, Spondon, near Derby. Application date, February 13, 1926.

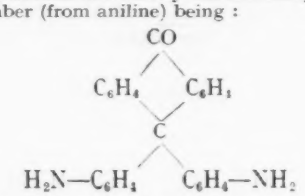
Acetic anhydride is frequently contaminated with sulphur compounds when prepared with the aid of sulphur halogen compounds. It is found that such acetic anhydride can be freed from sulphur by treatment with an alkali or an alkaline earth acetate and chlorine. According to an example the anhydride (1,000 parts) is mixed with powdered sodium acetate (60 parts), 7 parts of chlorine introduced, and the product distilled.

270,820. ACID PHOSPHATES, PROCESS FOR PRODUCING. E. C. R. Marks, London. From Parker Rust Proof Co., Detroit, U.S.A. Application date, February 16, 1926.

The dihydrogen orthophosphates of manganese, zinc, cadmium, and iron have been prepared on a small scale, from the metals and phosphoric acid, but the processes had to be conducted in the absence of air owing to their ready oxidation. It is now found that the absence of air is not necessary if the phosphoric acid is concentrated. Thus, iron (1 part) may be dissolved in 10 parts of phosphoric acid of 65 per cent. strength at about 115° C., and the ferrous dihydrogenphosphate $Fe(H_2PO_4)_2$ isolated by crystallising from the concentrated acid solution. The product must be dried quickly, but is then comparatively stable. The corresponding manganous and zinc compounds can be similarly prepared.

270,840. ANTHRAQUINONE DERIVATIVES, MANUFACTURE OF. O. Y. Imray, London. From I.G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. Application date, February 25, 1926.

These are produced by heating anthraquinone or a homologue thereof with salts of aromatic amines having the *p*-positions to the amino groups free. At temperatures below about 180° C. the products are chiefly bis-aminoarylanthrones, the simplest member (from aniline) being :



At higher temperatures the products are principally bis-aminoarylanthracenes, of the probable formula :

Examples are given of the production of both types of compounds from anthraquinone or β-methylanthraquinone and hydrochlorides of anilin, *o*-toluidine, or *o*-anisidine ; in each case the reaction is effected in the presence of an excess of the free base.

270,988 and 270,989. SULPHURIC ACID, MANUFACTURE OF. H. Petersen, 6, Hohenzollernstrasse, Berlin-Steglitz, Germany. International Convention date and application date, October 12, 1926, and December 16, 1926, respectively.

270,988. These specifications relate to the utilisation of sulphur dioxide-containing gases which contain large amounts of water vapour for the manufacture of sulphuric acid. According to 270,988, such gases, which would normally react with difficulty or yield only weak acid, are first treated to remove water, in a separate tower in front of the acid plant with sulphuric acid of about 60° Bé. The latter may be taken from a suitable place in the sulphuric acid system, but should not contain a too great percentage of nitrogen oxides. It removes water from the gases and is simultaneously denitrated ; it may be returned to the plant at a point at which water is required. It may be necessary to treat only a portion of the gases.

270,989. According to Specification 270,989 a portion of the sulphur dioxide-water-containing gases are used to effect denitration of the commercial acid, preferably in such quantity that little or no dilution of the acid occurs, the water being used up entirely in the process ; the remainder of the sulphur dioxide-bearing gases are then sent direct to the places in the plant where water is necessary for the formation of sulphuric acid. The use of a separate drying apparatus for the gases is thus avoided. The denitrating apparatus may conveniently be a tower packed with grains of an average diameter of 40 mm. or less, in order to ensure intimate contact between gases and acid.

271,016. HYDRATED CHROMIC CHLORIDE, MANUFACTURE OF. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. Application date, July 26, 1926.

Anhydrous chromic chloride, prepared, for example, by the method of Specification 269,028 (see THE CHEMICAL AGE, Vol. XVI, p. 486), does not dissolve directly in water but will dissolve in the presence of a reducing agent, for which purpose a small quantity of chromous chloride has been used, but possesses the disadvantage that air must be excluded. It is now found that solution of the chloride can readily be effected by exposing the aqueous suspension to the action of a cathodically polarised conductor, preferably lead ; the anode may be surrounded by a diaphragm to avoid contamination of the solution with anode oxidation products, or a chromium anode may be employed. As the reaction is exothermic, the temperature rises to boiling, and very concentrated solutions which solidify on cooling can be obtained. According to an example anhydrous chromium chloride produced from ferrochromium and containing carbon is suspended in water in a lead-lined vessel (which serves as cathode) containing a graphite anode within a clay diaphragm containing hydrochloric acid. Solution is rapidly effected by a small current, the solution being then filtered from carbon and crystallised.

271,023. ANTHRAQUINONE INTERMEDIATES. British Dyestuffs Corporation, Ltd., 70, Spring Gardens, Manchester, A. Shepherdson, W. W. Tatum, and H. M. Bunbury, Crumpsall Vale Chemical Works, Blackley, Manchester. Application date, January 11, 1926.

Halogenated derivatives of 1 : 4-diaminoanthraquinone are obtained by halogenating leuco 1 : 4-diaminoanthraquinone in presence of an inert or oxidising organic solvent. In an example the preparation of 2 : 3-dichlor-1 : 4-diaminoanthraquinone is shown.

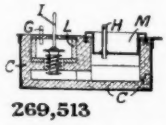
NOTE.—Abstracts of the following specifications, which are now accepted, appeared in THE CHEMICAL AGE when they became open to inspection under the International Convention :—249,515 (F. Lehnhof-Wyld), relating to organic arsenic compounds, see Vol. XIV, p. 551 ; 249,883 (I.G. Farbenindustrie Akt.-Ges.), relating to manufacture of aralkylamines, see Vol. XIV, p. 551 ; 250,955 (I.G. Farbenindustrie

Akt.-Ges.), relating to aromatic aldehydes, see Vol. XV, p. 34; 254,742 (I.G. Farbenindustrie Akt.-Ges.), relating to vat-dyestuffs containing nitrogen, see Vol. XV, p. 279; 255,837 (L. A. Van Dyk), relating to a polymerised vinyl chloride modification, see Vol. XV, p. 331; 259,204 (I.G. Farbenindustrie Akt.-Ges.), relating to the manufacture of esters, see Vol. XV, p. 548; 261,048 (F. J. S. Anderson, I. Siesbye, and N. J. H. Weitzmann), relating to complex aurothiosulphate compounds, see Vol. XVI, p. 70; 264,797 (Etablissements Poulenc Frères), relating to a stable solution of 3-acetylamino-4-oxyphenyl-arsenic acid), see Vol. XVI, p. 339; 264,804 (F. Hoffman La Roche and Co.), relating to ureides of dialkyl or arylalkylacetic acids, see Vol. XVI, p. 339.

International Specifications not yet Accepted

269,513. ELECTROLYSIS. F. Gerlach, Villa Wölfling, Drahowitz, Czecho-Slovakia. International Convention date, April 17, 1926.

When electrolysing a solution of an alkali chloride with a mercury cathode and decomposing the resulting amalgam in a chamber at a lower level, the transfer of the mercury to the electrode chamber L from the decomposition chamber C is effected by means of a rotating worm I, having above it a curved horizontal plate. The transfer is effected so quietly that a plate-shaped carbon anode may be fixed very close to the mercury cathode without fear of short-circuiting. A chlorine outlet G and a hydrogen outlet H are provided.



269,513

269,521. HYDROCARBONS AND THEIR OXYGENATED DERIVATIVES. I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. International Convention date, April 14, 1926.

These are produced by passing hydrogen with oxides of carbon at high temperature and pressure over catalysts containing metallic sulphides, such as cobalt or copper sulphide, or zinc chromate or metal oxides which have been treated with hydrogen sulphide. Pressures of 10 to 100 atmospheres and temperatures of 200° to 600° C. are mentioned. According to an example an oil resembling petroleum is obtained by passing water gas at 20 atmospheres pressure through an aluminium-lined chamber containing cobalt sulphide heated to 270° C.

269,522. DYES. I. G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. International Convention date, April 15, 1926.

Azo dyes containing chromable groups are converted into chromium derivatives by treatment with chromium compounds, the latter being employed in less quantity than to provide one atom of chromium for each chromable group present. The products differ from the known compounds of the same dyestuffs obtained with the use of larger quantities of chromium. Examples are given of the preparation of a compound from the dyestuff from 4-chlor-2-aminophenol-5-sulphonic acid and 1-phenyl-3-methyl-5-pyrazolone and of a compound from the dyestuff from 4-nitro-2-aminophenol-6-sulphonic acid and β-naphthol. As compared with the compounds containing more chromium the first-mentioned compound dyes wool pure red instead of yellowish red shades, and the second compound black instead of violet-brown.

269,529 and 269,530. CELLULOSE ESTERS. British Celanese, Ltd., 8, Waterloo Place, London. International Convention date, April 14, 1926.

269,529. Nitrocelluloses and other inorganic acid esters of cellulose are produced by treating cellulose or cellulosic materials with one or more inorganic acids in the presence of one or more phosphoric acids, especially orthophosphoric acid containing metaphosphoric acid. As inorganic acids there are specified nitric, sulphuric, ethylsulphuric, benzenesulphonic and *p*-toluenesulphonic acids. The process is applicable to the treatment of cellulosic fabrics and wood.

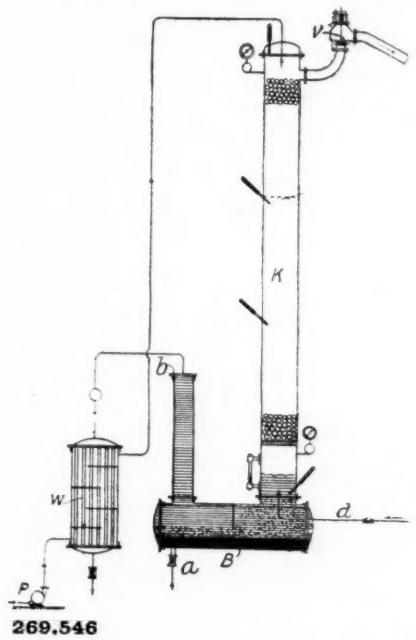
269,530. This is similar to 269,529, and describes the production of organic acid esters of cellulose. As organic acids are mentioned formic, acetic, propionic, butyric, lactic, oleic, palmitic, stearic, and benzoic acids, also the fatty acids derived from coconut oil.

269,531. CELLULOSE ETHERS. British Celanese, Ltd., 8, Waterloo Place, London. International Convention date, April 16, 1926.

These are produced by treating cellulose or cellulosic materials with an etherifying agent in presence of one or more phosphoric acids, particularly orthophosphoric acid containing metaphosphoric acid. The etherifying agent is of the general formula R-X, where R is an alkyl, aryl, or aralkyl group, and X is a hydroxyl group or a mono- or poly-basic acid group deprived of one or more salt-forming hydrogen atoms, such as HSO_4, SO_4, NO_3, CH_3COO, or C_2H_5COO. Benzyl alcohol, benzyl chloride, and mono- or dibenzyl sulphate are specified.

269,546. SULPHUR AND AMMONIUM SULPHIDE. I.G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. International Convention date, April 16, 1926.

Ammonium polysulphide solution obtained in extracting sulphur from materials by means of ammonium sulphide is decomposed by steam under pressure so as to separate liquid sulphur. The polysulphide solution is forced through the heat-exchanger *W* into the top of the column *K*, into the base of which steam at 2–3 atmospheres pressure is admitted by the pipe *d*; molten sulphur is drawn off at *a* and water is discharged through the rising pipe *b* and the heat-exchanger *W*. Vapours escape by the valve *V* and are condensed to form ammonium sulphide solution.



269.546

269,547. HYDROCARBONS AND HYDROGEN. I.G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. International Convention date, April 15, 1926.

In order to obtain unsaturated hydrocarbons and hydrogen from saturated hydrocarbons, the latter are subjected to a treatment for producing unsaturated hydrocarbons, these being separated; the residual gases are then converted by treatment with steam or oxygen into a mixture containing carbon monoxide and hydrogen, which mixture may be converted either into methanol or into carbon dioxide and hydrogen by treatment with steam. The unsaturated hydrocarbons may be produced from the saturated hydrocarbons by electric heating by means of an electric arc or by incomplete combustion as described in Specifications 264,845 and 265,234 (see THE CHEMICAL AGE, Vol. XVI, pp. 340 and 381); they may be separated as such or after conversion into other products such as benzene or acetaldehyde. According to examples (1) methane containing some hydrogen is passed through an electric arc and acetylene absorbed from the product by active charcoal; the residual gases are then heated to 1100° C. by preheating and partial combustion, and

passed with steam over a nickel-alumina catalyst to convert them into a mixture of hydrogen and oxides of carbon; (2) natural gas is subjected to partial combustion to produce acetylene and passed over graphite-coated silica to form benzene, which is adsorbed in active charcoal; the residual gases are subjected to partial combustion, mixed with steam, and passed over a nickel-magnesia catalyst, whereby there is produced a hydrogen-carbon monoxide mixture suitable, after purification, for the synthesis of methanol.

LATEST NOTIFICATIONS.

272,469. Production of anthraquinone derivatives. I. G. Farbenindustrie Akt.-Ges. June 8, 1926.
272,482. Production of dyeings on cellulose esters or ethers. I. G. Farbenindustrie Akt.-Ges. June 8, 1926.
272,483. Manufacture and production of valuable hydrocarbons from mineral oils, tars, and the like. I. G. Farbenindustrie Akt.-Ges. June 11, 1926.
272,526. Process for the extraction of hydrocarbon oils from coal. Trautmann, J. June 11, 1926.
272,528. Manufacture of compounds of the perylene series. I. G. Farbenindustrie Akt.-Ges. June 9, 1926.
272,538. Destructive hydrogenation of carbonaceous materials. I. G. Farbenindustrie Akt.-Ges. June 11, 1926.
272,539. Process for the treatment of coal, tars, mineral oils, and the like and apparatus therefor. I. G. Farbenindustrie Akt.-Ges. June 11, 1926.
272,555. Catalysts and catalytic processes. Du Pont de Nemours and Co., E. I. June 12, 1926.
272,556. Manufacture and production of valuable liquid hydrocarbons and their derivatives, particularly those of low boiling-point, from coal, tars, mineral oils, and the like. I. G. Farbenindustrie Akt.-Ges. June 14, 1926.
272,557. Carrying-out catalytic oxidations in the gaseous or vapour state. I. G. Farbenindustrie Akt.-Ges. June 14, 1926.

Specifications Accepted with Date of Application

244,463. New anthraquinone derivatives, Manufacture of. Badische Anilin und Soda Fabrik. December 9, 1924.
246,128. Phosphoric acid, Process for the production of. I.G. Farbenindustrie Akt.-Ges. January 17, 1925.
247,217. Method of working with carbon monoxide. I.G. Farbenindustrie Akt.-Ges. February 7, 1925.
247,219. Phosphorus, Process for the production of. I.G. Farbenindustrie Akt.-Ges. February 6, 1925.
249,884. Azo dyestuffs containing metal, Manufacture of. Soc. of Chemical Industry in Basle. March 28, 1925.
251,997. Compounds containing carbocyclic and heterocyclic rings, Manufacture of. I. G. Farbenindustrie Akt.-Ges. May 5, 1925.
252,390. Dyestuffs, Manufacture of. I. G. Farbenindustrie Akt.-Ges. May 22, 1925.
252,399. Aluminium oxide, Manufacture of. Aktieselkapet Norsk Aluminium Co. May 23, 1925.
253,865. Production of azo dyestuffs on Silk, Process for. I. G. Farbenindustrie Akt.-Ges. June 20, 1925.
254,708. Azo dyestuffs and chromium derivatives thereof. Soc. of Chemical Industry in Basle. July 3, 1925.
257,917. Manufacture of phosphorous or phosphoric acid and activated charcoal. Soc. pour l'Exploitation des Procédés Edouard Urbain. September 4, 1925.
260,543. Tanning agents, Manufacture of. I. G. Farbenindustrie Akt.-Ges. October 28, 1925.
261,356. Obtaining the active constituents of germ glands. Chemische Fabrik auf Actien (vorm. E. Schering). November 12, 1925.
261,388. Gases for the synthesis of ammonia, Method of purifying. November 12, 1925.
261,722. Cyanides of alkali-forming metals. California Cyanide Co., Inc. November 23, 1925.
261,747. Amines of the cyclohexane series, Manufacture of. I. G. Farbenindustrie Akt.-Ges. November 17, 1925.
262,455. Purification of hydrogen. I. G. Farbenindustrie Akt.-Ges. December 4, 1925.
263,088. Dyeing fast mixed shades on silk. I. G. Farbenindustrie Akt.-Ges. December 21, 1925. Addition to 253,865.
264,508. Chloriodo compounds of alpha-aminopyridine and its derivatives. Chemische Fabrik auf Actien vorm. E. Schering. January 15, 1926.
267,954. Unsaturated aldehydes, Manufacture of. H. Rupe. March 22, 1926.
271,924. Apparatus for electromagnetic separation of ores. A. Davies. January 28, 1926.
271,940. Complex antimony compounds. W. Carpmael. (*I. G. Farbenindustrie Akt.-Ges.*) March 1, 1926.
271,942. N-Dihydro-1 : 2 : 2^1 : 1^1-anthraquinone azine. E. C. R. Marks. (*E. I. Du Pont de Nemours and Co.*). March 2, 1926.
271,969. Acid amides and salts, Production of. Synthetic Ammonia and Nitrates, Ltd., P. A. Smith, and H. G. Smith. March 13, 1926.
272,024. Pyrazolone dyestuffs. British Dyestuffs Corporation, Ltd., and M. Mendoza. May 12, 1926.
272,053. Conversion of lead sulphide into lead carbonate. S. C. Smith. June 29, 1926.

Applications for Patents

Austin, W., and Bailey, F. T. Production of white lead. 16,105. June 16. (United States, June 22, 1926.)
Carpmael, A., and I. G. Farbenindustrie Akt.-Ges. Process of conserving foods, etc. 15,864. June 14.
Carpmael, A., and I. G. Farbenindustrie Akt.-Ges. Manufacture of compounds from indene and phenols. 15,865. June 14.
Carpmael, A., and I. G. Farbenindustrie Akt.-Ges. Manufacture of condensation products of the aromatic series. 15,996. June 15.
Carpmael, K. (legal representative of Carpmael, W.), and I. G. Farbenindustrie Akt.-Ges. Manufacture of dyestuffs. 16,087. June 16.
Carroll, J. C. Anti-corrosive heat-resisting paint, etc. 16,233. June 18.
Chemical Works, formerly Sandoz. Oxidation of aldoses. 16,187. June 17.
Chemische Fabrik auf Actien vorm. E. Schering. Manufacture of mixed alkaloid salts. 15,766. June 14. (Germany, June 26, 1926.)
Chemische Fabrik auf Actien vorm. E. Schering. Manufacture of condensation products from alkylated phenols and ketones. 15,992. June 15. (Germany, June 29, 1926.)
Chemische Fabrik auf Actien vorm. E. Schering. Manufacture of alkylisopropylphenols, etc. 15,993. June 15. (Germany, June 29, 1926.)
Chemische Fabrik auf Actien vorm. E. Schering. Manufacture of alkylisopropylenephenols, etc. 15,994. June 15. (Germany, June 29, 1926.)
Chemische Fabrik auf Actien vorm. E. Schering. Manufacture of alkylated phenols, etc. 16,198. June 17. (Germany, July 14, 1926.)
Consortium für Elektrochemische Industrie Ges. Manufacture of acetic anhydride. 15,966. June 15. (Germany, June 16, 1926.)
Consortium für Elektrochemische Industrie Ges. Manufacture of acetic anhydride. 16,179. June 17. (Germany, June 17, 1926.)
Du Pont de Nemours and Co., E. I. Catalysts, etc. 15,717. June 13. (United States, June 12, 1926.)
Du Pont de Nemours and Co., E. I., and Nobel Industries, Ltd. Coating-composition. 16,262. June 18.
I. G. Farbenindustrie Akt.-Ges., and Mond, A. L. Bleaching linen, hemp, etc. 14,989. June 7.
I. G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Anthraquinone dyestuffs. 15,163. June 7.
I. G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Manufacture of hydrocarbons. 15,411, 15,412, 15,413. June 9.
I. G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Treatment of montan wax. 15,414. June 9.
I. G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Manufacture of dyestuffs. 15,416. June 9.
I. G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Manufacture of dyestuffs. 15,528. June 10.
I. G. Farbenindustrie Akt.-Ges. Manufacture of hydrocarbons. 15,262. June 8. (March 13, 1926.)
I. G. Farbenindustrie Akt.Ges. Manufacture of active silica. 15,415. June 9.
I. G. Farbenindustrie Akt.-Ges. Manufacture of perylene compounds. 15,422. June 9. (Germany, June 9, 1926.)
I. G. Farbenindustrie Akt.-Ges. Method of storing dibasic calcium hypochlorite. 15,515. June 10. (Germany, August 18, 1926.)
I. G. Farbenindustrie Akt.-Ges. Destructive hydrogenation of carbonaceous materials. 15,525. June 10. (Germany, June 11, 1926.)
I. G. Farbenindustrie Akt.-Ges. Treatment of coal, tars, etc. 15,526. June 10. (Germany, June 11, 1926.)
I. G. Farbenindustrie Akt.-Ges. Manufacture of active silica gels. 15,527. June 10.
I. G. Farbenindustrie Akt.-Ges. Production of cleansing, etc., agents. 15,615. June 11. (October 13, 1926.)
I. G. Farbenindustrie Akt.-Ges. and Johnson, J. Y. Manufacture of calcium nitrate, etc. 16,067. June 16.
Jungmann, K., and Kolbert, O. Manufacture of a solid alcoholic solution of iodine. 15,265. June 8.
Metallbank und Metallurgische Ges. Akt.-Ges., and Mond, A. L. Disintegrating liquid alumina. 15,011. June 7.
Petersen, H. Manufacture of sulphuric acid. 15,115. June 7.
Wessel, C. Distillation of coal tar. 15,252. June 8. (Germany, June 29, 1926.)

Weekly Prices of British Chemical Products

The prices and comments given below respecting British chemical products are based on direct information supplied by the British manufacturers concerned. Unless otherwise qualified, the figures quoted apply to fair quantities, net and naked at makers' works.

General Heavy Chemicals

ACID ACETIC, 40% TECH.—£19 per ton.

ACID BORIC, COMMERCIAL.—Crystal, £34 per ton; powder, £36 per ton.

ACID HYDROCHLORIC.—3s. 9d. to 6s. per carboy d/d, according to purity, strength, and locality.

ACID NITRIC, 80° Tw.—£21 10s. to £27 per ton, makers' works, according to district and quality.

ACID SULPHURIC.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations: 140° Tw., Crude Acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.

AMMONIA ALKALI.—£6 15s. per ton f.o.r. Special terms for contracts.

BISULPHITE OF LIME.—£7 10s. per ton, packages extra, returnable.

BLEACHING POWDER.—Spot, £9 10s. per ton d/d; Contract, £8 10s. per ton d/d, 4-ton lots.

BORAX, COMMERCIAL.—Crystals, £19 10s. to £20 per ton; granulated, £19 per ton; powder, £21 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain.)

CALCIUM CHLORIDE (SOLID).—£5 to £5 5s. per ton d/d carr. paid.

COPPER SULPHATE.—£25 to £25 10s. per ton.

METHYLATED SPIRIT 61 O.P.—Industrial, 2s. 5d. to 2s. 10d. per gall.; pyridinised industrial, 2s. 7d. to 3s. per gall.; mineralised, 3s. 6d. to 3s. 10d. per gall.; 64 O.P., 1d. extra in all cases; prices according to quantity.

NICKEL SULPHATE.—£38 per ton d/d.

NICKEL AMMONIA SULPHATE.—£38 per ton d/d.

POTASH CAUSTIC.—£30 to £33 per ton.

POTASSIUM BICHROMATE.—4½d. per lb.

POTASSIUM CHLORATE.—3½d. per lb., ex wharf, London, in cwt. kegs.

SALAMMONIAC.—£45 to £50 per ton d/d. Chloride of ammonia, £37 to £45 per ton, carr. paid.

SALT CAKE.—£3 15s. to £4 per ton d/d. In bulk.

SODA CAUSTIC, SOLID.—Spot lots delivered, £15 2s. 6d. to £18 per ton, according to strength; 20s. less for contracts.

SODA CRYSTALS.—£5 to £5 5s. per ton, ex railway depots or ports.

SODIUM ACETATE 97/98%.—£21 per ton.

SODIUM BICARBONATE.—£10 10s. per ton, carr. paid.

SODIUM BICHROMATE.—3½d. per lb.

SODIUM BISULPHITE POWDER, 60/62%.—£17 10s. per ton for home market, 1-cwt. drums included.

SODIUM CHLORATE.—2¾d. per lb.

SODIUM NITRITE, 100% BASIS.—£27 per ton d/d.

SODIUM PHOSPHATE.—£14 per ton, f.o.r. London, casks free.

SODIUM SULPHATE (GLAUBER SALTS).—£3 12s. 6d. per ton.

SODIUM SULPHIDE CONC. SOLID, 60/65.—£13 5s. per ton d/d. Contract, £13. Carr. paid.

SODIUM SULPHIDE CRYSTALS.—Spot, £8 12s. 6d. per ton d/d. Contract, £8 10s. Carr. paid.

SODIUM SULPHITE, PEA CRYSTALS.—£14 per ton f.o.r. London, 1-cwt. kegs included.

Coal Tar Products

ACID CARBOLIC CRYSTALS.—8d. to 9d. per lb. Crude 60's, 2s. 4d. to 2s. 8d. per gall.

ACID CRESYLIC 99/100.—2s. 8d. to 2s. 9d. per gall. 97/99.—2s. 1½d. to 2s. 3d. per gall. Pale, 95%, 2s. to 2s. 2d. per gall. Dark, 1s. 9d. to 2s. 1d. per gall.

ANTHRACENE.—A quality, 2½d. to 3d. per unit. 40%, 3d. per unit.

ANTHRACENE OIL, STRAINED.—8d. to 8½d. per gall. Unstrained, 7½d. to 8d. per gall.; both according to gravity.

BENZOLE.—Crude 65's, 1s. 0¾d. to 1s. 1¾d. per gall., ex works in tank wagons. Standard Motor, 1s. 9d. to 2s. 2d. per gall., ex works in tank wagons. Pure, 1s. 7d. to 2s. 6d. per gall., ex works in tank wagons.

TOLUOLE.—90%, 1s. 8d. to 2s. 0½d. per gall. Firm. Pure, 1s. 10d. to 2s. 3½d. per gall.

XYLOL.—1s. 11d. to 2s. 4d. per gall. Pure, 2s. 6d. per gall.

CREOSOTE.—Cresylic, 20/24%, 10½d. per gall. Standard specification, 6¾d. to 9d.; middle oil, 7½d. to 8d. per gall. Heavy, 8½d. to 8¾d. per gall. Salty, 7d. per gall. less 1½%.

NAPHTHA.—Crude, 8d. to 9d. per gall. according to quality. Solvent 90/160, 1s. 3d. to 1s. 11d. per gall. Solvent 95/160, 1s. 5d. to 1s. 6d. per gall. Solvent 90/190, 1s. 1½d. to 1s. 4d. per gall.

NAPHTHALENE CRUDE.—Drained Creosote Salts, £7 10s. per ton. Whizzed or hot pressed, £8 10s. to £9 per ton.

NAPHTHALENE.—Crystals, £11 10s. to £13 10s. per ton. Quiet. Flaked, £12 10s. per ton, according to districts.

PITCH.—Medium soft, 72s. 6d. to 82s. 6d. per ton, according to district; nominal.

PYRIDINE.—90/140, 7s. 6d. to 13s. per gall. Nominal. 90/180, 4s. 6d. to 5s. per gall. Heavy, 5s. to 8s. per gall.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated:

ACID AMIDONAPHTHOL DISULPHO (1-8-2-4).—10s. 9d. per lb.

ACID ANTHRANILIC.—6s. per lb. 100%.

ACID BENZOIC.—1s. 9d. per lb.

ACID GAMMA.—4s. 9d. per lb.

ACID H.—3s. 3d. per lb. 100% basis d/d.

ACID NAPHTHIONIC.—1s. 6d. per lb. 100% basis d/d.

ACID NEVILLE AND WINTHER.—4s. 9d. per lb. 100% basis d/d.

ACID SULPHANILIC.—9d. per lb. 100% basis d/d.

ANILINE OIL.—7½d. per lb. naked at works.

ANILINE SALTS.—7½d. per lb. naked at works.

BENZALDEHYDE.—2s. 3d. per lb.

BENZIDINE BASE.—3s. 3d. per lb. 100% basis d/d.

BENZOIC ACID.—1s. 8½d. per lb.

o-CRESOL 29/31° C.—4½d. per lb. Fair inquiry.

m-CRESOL 98/100%.—3s. per lb. Only limited inquiry.

p-CRESOL 32/34° C.—2s. 8¾d. per lb. Only limited inquiry.

DICHLORANILINE.—2s. 3d. per lb.

DIMETHYLANILINE.—1s. 11d. per lb. d/d. Drums extra.

DINITROBENZENE.—9d. per lb. naked at works. £75 per ton.

DINITROCHLORBENZENE.—£84 per ton d/d.

DINITROTOLUENE.—48/50° C. 8d. per lb. naked at works. 66/68° C 9d. per lb. naked at works.

DIPHENYLAMINE.—2s. 10d. per lb. d/d.

a-NAPHTHOL.—2s. per lb. d/d.

B-NAPHTHOL.—11d. to 1s. per lb. d/d.

a-NAPHTHYLAMINE.—1s. 3d. per lb. d/d.

B-NAPHTHYLAMINE.—3s. per lb. d/d.

o-NITRANILINE.—5s. 9d. per lb.

m-NITRANILINE.—3s. per lb. d/d.

p-NITRANILINE.—1s. 9d. per lb. d/d.

NITROBENZENE.—6d. per lb. naked at works.

NITRONAPHTHALENE.—1s. 3d. per lb. d/d.

R. SALT.—2s. 2d. per lb. 100% basis d/d.

SODIUM NAPHTHIONATE.—1s. 8½d. per lb. 100% basis d/d.

o-TOLUIDINE.—7½d. per lb. naked at works.

p-TOLUIDINE.—2s. 2d. per lb. naked at works.

m-XYLIDINE ACETATE.—2s. 11d. per lb. 100%.

Wood Distillation Products

ACETATE OF LIME.—Brown, £8 10s. to £9 5s. per ton. Grey, £15 10s. per ton. Liquor, 9d. per gall. 32° Tw.

CHARCOAL.—£6 15s. to £10 per ton, according to grade and locality.

IRON LIQUOR.—1s. 3d. per gall. 32° Tw. 1s. per gall. 24° Tw.

RED LIQUOR.—9d. to 10d. per gall. 16° Tw.

WOOD CREOSOTE.—1s. 9d. per gall. Unrefined.

WOOD NAPHTHA, MISCIBLE.—3s. 9d. to 4s. per gall., 60% O.P. Solvent, 3s. 11d. to 4s. 3d. per gall., 40% O.P.

WOOD TAR.—£4 to £5 10s. per ton and upwards, according to grade

BROWN SUGAR OF LEAD.—£40 15s. to £41 10s. per ton.

Rubber Chemicals

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 5½d. per lb., according to quality; Crimson, 1s. 4d. to 1s. 6d. per lb., according to quality.

ARSENIC SULPHIDE, YELLOW.—1s. 9d. per lb.

BARYTES.—£3 10s. to £6 15s. per ton, according to quality.

CADMIUM SULPHIDE.—2s. 6d. to 2s. 9d. per lb.

CARBON BISULPHIDE.—£20 to £25 per ton, according to quantity.

CARBON BLACK.—5½d. per lb., ex wharf.

CARBON TETRACHLORIDE.—£45 to £50 per ton, according to quantity, drums extra.

CHROMIUM OXIDE, GREEN.—1s. 1d. per lb.

DIPHENYLGUANIDINE.—3s. 9d. per lb.

INDIARUBBER SUBSTITUTES, WHITE AND DARK.—5¾d. to 6¾d. per lb.

LAMP BLACK.—£35 per ton, barrels free.

LEAD HYPOSULPHITE.—9d. per lb.

LITHOPONE, 30%.—£22 10s. per ton.

MINERAL RUBBER "RUBPRON."—£13 12s. 6d. per ton, f.o.r. London.

SULPHUR.—£9 to £11 per ton, according to quality.

SULPHUR CHLORIDE.—4d. to 7d. per lb., carboys extra.

SULPHUR PRECIP. B.P.—£47 10s. to £50 per ton.

THIOCARBAMIDE.—2s. 6d. to 2s. 9d. per lb. carriage paid.

THIOCARBANILIDE.—2s. 1d. to 2s. 3d. per lb.

VERMILION, PALE OR DEEP.—6s. to 6s. 3d. per lb.

ZINC SULPHIDE.—1s. per lb.

Pharmaceutical and Photographic Chemicals

ACID, ACETIC, PURE, 80%.—£39 per ton ex wharf London in glass containers.

ACID, ACETYL SALICYLIC.—2s. 5d. to 2s. 6d. per lb.

ACID, BENZOIC B.P.—2s. to 2s. 3d. per lb., according to quantity. Solely ex Gum, 1s. to 1s. 3d per oz., according to quantity.

ACID, BORIC B.P.—Crystal, £40 to £41 per ton; powder, £44 to £45 per ton. Carriage paid any station in Great Britain, in ton lots.
ACID, CAMPHORIC.—19s. to 21s. per lb.
ACID, CITRIC.—1s. 6½d. to 1s. 7½d. per lb., less 5%.
ACID, GALLIC.—2s. 8d. per lb. for pure crystal, in cwt. lots.
ACID, PYROGALLIC, CRYSTALS.—7s. 3d. per lb. Resublimed, 8s. 3d. per lb.
ACID, SALICYLIC, B.P.—Pulv., 1s. 3½d. to 1s. 10d. per lb.; crystals, 1s. 10d. to 1s. 11d. per lb. Technical.—11½d. to 1s. per lb.
ACID, TANNIC B.P.—2s. 9d. to 2s. 11d. per lb.
ACID, TARTARIC.—1s. 3½d. per lb., less 5%. Firm market.
AMIDOL.—9s. per lb., d/d.
ACETANILIDE.—1s. 6d. to 1s. 8d. per lb. for quantities.
AMIDOPYRIN.—8s 6d. per lb.
AMMONIUM BENZOATE.—3s. 3d. to 3s. 9d. per lb., according to quantity.
AMMONIUM CARBONATE B.P.—£37 per ton. Powder, £39 per ton in 5 cwt. casks. Resublimated: lump, 1s. per lb.; powder, 1s. 3d. per lb.
ATROPINE SULPHATE.—11s. per oz. for English make.
BARBITONE.—6s. 6d. per lb.
BENZONAPHTHOL.—3s. 3d. per lb. spot.
BISMUTH CARBONATE.—9s. 9d. to 10s. per lb.
BISMUTH CITRATE.—9s. 6d. to 9s. 9d. per lb.
BISMUTH SALICYLATE.—8s. 9d. to 9s. per lb.
BISMUTH SUBNITRATE.—7s. 9d. to 8s. per lb.
BISMUTH NITRATE.—5s. 9d. to 6s. per lb.
BISMUTH OXIDE.—13s. 9d. to 14s. per lb.
BISMUTH SUBCHLORIDE.—11s. 9d. to 12s. per lb.
BISMUTH SUBGALLATE.—7s. 9d. to 8s. per lb. Extra and reduced prices for smaller and larger quantities respectively; Liquor Bismuthi B.P. in W. Qts. 1s. 1d. per lb.; 12 W. Qts. 1s. per lb.; 36 W. Qts. 11½d. per lb.
BORAX B.P.—Crystal, £24 to £27 per ton; powder, £26 to £29 per ton, according to quantity. Carriage paid any station in Great Britain, in ton lots.
BROMIDES.—Potassium, 1s. 11d. to 2s. per lb.; sodium, 2s. 2d. to 2s. 3d. per lb.; ammonium, 2s. 4d. to 2s. 5d. per lb., all spot.
CALCIUM LACTATE.—1s. 3½d. to 1s. 5d.
CHLORAL HYDRATE.—3s. 2d. to 3s. 5d. per lb., duty paid.
CHLOROFORM.—2s. 3d. to 2s. 7½d. per lb., according to quantity.
CREOSOTE CARBONATE.—6s. per lb.
ETHERS.—Prices for Winchester quarts; dozen Winchester quarts; carboys or drums; and 10 cwt. lots respectively: ·730—1s. 2½d.; 1s. 2d.; 1s. 1½d.; 1s. 0½d.; ·720 technical—1s. 5½d.; 1s. 5d.; 1s. 4½d.; 1s. 3½d.; ·720 pur. (Aether B.P., 1914)—2s. 4d.; 2s. 3½d.; 2s. 3d.; 2s. 2d.
FORMALDEHYDE.—£39 per ton, in barrels ex wharf.
GUAIACOL CARBONATE.—5s. per lb.
HEXAMINE.—2s. 4d. to 2s. 6d. per lb.
HOMATROPINE HYDROBROMIDE.—30s. per oz.
HYDRASTINE HYDROCHLORIDE.—English make offered at 120s. per oz.
HYDROGEN PEROXIDE (12 VOLS.).—1s. 4d. per gallon, f.o.r. makers' works, naked. B.P., 1 lb., 16s. per doz.; ½ lb., 9s. 6d. per doz.; ¼ lb., 6s. 6d. per doz.
HYDROQUINONE.—4s. per lb., in cwt. lots.
HYPOPHOSPHITES.—Calcium, 3s. 6d. per lb., for 28-lb. lots; potassium, 4s. 1d. per lb.; sodium, 4s. per lb.
IRON AMMONIUM CITRATE B.P.—2s. 1d. to 2s. 4d. per lb. Green, 2s. 4d. to 2s. 9d. per lb. U.S.P., 2s. 2d. to 2s. 5d. per lb.
IRON PERCHLORIDE.—4d. per lb. to 22s. per cwt., according to quantity.
MAGNESIUM CARBONATE.—Light Commercial, £31 per ton net.
MAGNESIUM OXIDE.—Light commercial, £62 10s. per ton, less 2½%; Heavy Commercial, £21 per ton, less 2½%; in quantity lower; Heavy Pure, 2s. to 2s. 3d. per lb., in 1 cwt. lots.
MENTHOL.—A.B.R. recrystallised B.P., 18s. 3d. per lb. net; Synthetic detached crystals, 11s. to 14s. 6d. per lb., according to quantity; Liquid (95%), 12s. per lb.
MERCURIALS B.P.—Up to 1 cwt. lots, Red Oxide, 7s. 6d. to 7s. 7d. per lb., levig., 7s. to 7s. 1d. per lb.; Corrosive Sublimate, Lump, 5s. 9d. to 5s. 10d. per lb., Powder, 5s. 2d. to 5s. 3d. per lb.; White Precipitate, Lump, 5s. 11d. to 6s. per lb., Powder, 6s. to 6s. 1d. per lb., Extra Fine, 6s. 1d. to 6s. 2d. per lb.; Calomel, 6s. 4d. to 6s. 5d. per lb.; Yellow Oxide, 6s. 10d. to 6s. 11d. per lb.; Persulph., B.P.C., 6s. 1d. to 6s. 2d. per lb.; Sulph. nig., 5s. 10d. to 5s. 11d. per lb. Special prices for larger quantities.
METHYL SALICYLATE.—1s. 9d. per lb.
METHYL SULPHONAL.—11s. per lb.
METOL.—11s. per lb. British make.
PARAFORMALDEHYDE.—1s. 9d. per lb. for 100% powder.
PARALDEHYDE.—1s. 4d. per lb.
PHENACETIN.—3s. per lb.
PHENAZONE.—4s. 6d. per lb.
PHENOLPHTHALEIN.—6s. to 6s. 3d. per lb.
POTASSIUM BITARTRATE 99/100% (Cream of Tartar).—100s. per cwt. less 2½% for ton lots.
POTASSIUM CITRATE.—1s. 11d. to 2s. 2d. per lb.
POTASSIUM FERRICYANIDE.—1s. 9d. per lb., in cwt. lots.
POTASSIUM IODIDE.—16s. 8d. to 17s. 2d. per lb. for 1 cwt. lots.
POTASSIUM METABISULPHITE.—6d. per lb., 1-cwt. kegs included, f.o.r. London.
POTASSIUM PERMANGANATE.—B.P. crystals, 6d. per lb., spot.
QUININE SULPHATE.—2s. per oz., 1s. 8d. to 1s. 9d. for 1000 oz. lots in 100 oz. tins.
RESORCIN.—4s. per lb., spot.
SACCHARIN.—55s. per lb.; in quantity lower.
SALOL.—2s. 4d. per lb.
SODIUM BENZOATE, B.P.—1s. 10d. to 2s. 2d. per lb.
SODIUM CITRATE, B.P.C., 1911.—1s. 8d. to 1s. 11d. per lb., B.P.C., 1923—2s. to 2s. 1d. per lb. for 1 cwt. lots. U.S.P., 1s. 11d. to 2s. 2d. per lb., according to quantity.
SODIUM FERROCYANIDE.—4d. per lb., carriage paid.
SODIUM HYPOSULPHITE, PHOTOGRAPHIC.—£15 5s. per ton, d/d consignee's station in 1-cwt. kegs.
SODIUM NITROPRUSSIDE.—16s. per lb.
SODIUM POTASSIUM TARTRATE (ROCHELLE SALT).—90s. to 95s. per cwt. Crystals, 5s. per cwt. extra.
SODIUM SALICYLATE.—Powder, 1s. 9d. to 1s. 10d. per lb. Crystal, 1s. 10d. to 1s. 11d. per lb.
SODIUM SULPHIDE, PURE RECRYSTALLISED.—10d. to 1s. 2d. per lb.
SODIUM SULPHITE, ANHYDROUS, £27 10s. to £28 10s. per ton, according to quantity; 1-cwt. kegs included.
SULPHONAL.—7s. 6d. per lb.
TARTAR EMETIC, B.P.—Crystal or powder, 2s. 1d. to 2s. 3d. per lb.
THYMOL.—Puriss., 10s. 6d. to 11s. 6d. per lb., according to quantity. Firmer. Natural, 12s. 6d. per lb. Cheaper.

Perfumery Chemicals

ACETOPHENONE.—7s. 3d. per lb.
AUBEPINE (EX ANETHOL), 10s. 6d. per lb.
AMYL ACETATE.—2s. per lb.
AMYL BUTYRATE.—5s. 3d. per lb.
AMYL SALICYLATE.—3s. per lb.
ANETHOL (M.P. 21/22° C.).—5s. 6d. per lb.
BENZYL ACETATE FROM CHLORINE-FREE BENZYL ALCOHOL.—2s. per lb.
BENZYL ALCOHOL FREE FROM CHLORINE.—2s. per lb.
BENZALDEHYDE FREE FROM CHLORINE.—2s. 6d. per lb.
BENZYL BENZOATE.—2s. 6d. per lb.
CINNAMIC ALDEHYDE NATURAL.—17s. per lb.
COUMARIN.—10s. per lb.
CITRONELLOL.—14s. 6d. per lb.
CITRAL.—8s. 9d. per lb.
ETHYL CINNAMATE.—7s. 6d. per lb.
ETHYL PHTHALATE.—2s. 9d. per lb.
EUGENOL.—9s. per lb.
GERANIOL (PALMAROSA).—17s. 6d. per lb.
GERANIOL.—6s. 6d. to 10s. per lb.
HELIOTROPINE.—4s. 9d. per lb.
ISO EUGENOL.—13s. 6d. per lb.
LINALOL.—Ex Bois de Rose, 15s. per lb. Ex Shui Oil, 10s. 6d. per lb.
LINALYL ACETATE.—Ex Bois de Rose, 18s. per lb. Ex Shui Oil, 14s. 6d. per lb.
METHYL ANTHRANILATE.—8s. 6d. per lb.
METHYL BENZOATE.—4s. 6d. per lb.
MUSK KETONE.—35s. per lb.
MUSK XYLOL.—8s. 6d. per lb.
NEROLIN.—3s. 9d. per lb.
PHENYL ETHYL ACETATE.—10s. 6d. per lb.
PHENYL ETHYL ALCOHOL.—10s. 6d. per lb.
RHODINOL.—32s. 6d. per lb.
SAFROL.—1s. 6d. per lb.
TERPINEOL.—1s. 6d. per lb.
VANILLIN.—17s. to 18s. 6d. per lb. Good demand.

Essential Oils

ALMOND OIL.—10s. 3d. per lb.
ANISE OIL.—3s. 1d. per lb.
BERGAMOT OIL.—28s. 6d. per lb.
BOURBON GERANIUM OIL.—14s. 9d. per lb.
CAMPHOR OIL.—67s. 6d. per cwt.
CANANGA OIL, JAVA.—26s. per lb.
CINNAMON OIL LEAF.—6d. per oz.
CASSIA OIL, 80/85%.—8s. 3d. per lb.
CITRONELLA OIL.—Java, 85/90%, 1s. 11d. per lb. Ceylon, pure, 1s. 9d. per lb.
CLOVE OIL.—6s. per lb.
EUCALYPTUS OIL, 70/75%.—2s. 3d. per lb.
LAVENDER OIL.—Mont Blanc, 38/40%, Esters, 21s. per lb.
LEMON OIL.—8s. per lb.
LEMONGRASS OIL.—4s. 6d. per lb.
ORANGE OIL, SWEET.—10s. 6d. per lb.
OTTO OF ROSE OIL.—Anatolian, 30s. per oz. Bulgarian, 70s. per oz.
PALMA ROSA OIL.—10s. 6d. per lb.
PEPPERMINT OIL.—Wayne County, 18s. per lb. Japanese, 8s. per lb.
PETITGRAIN OIL.—7s. 6d. per lb.
SANDALWOOD OIL.—Mysore, 26s. 6d. per lb.; 90/95%, 16s. 6d. per lb.

London Chemical Market

The following notes on the London Chemical Market are specially supplied to* THE CHEMICAL AGE *by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., and may be accepted as representing these firms' independent and impartial opinions.

London, June 23, 1927.

TRADE has been somewhat brighter during the past week. Prices on the whole are very firm. Export demand is without feature.

General Chemicals

ACETONE is a firm market at about £60 to £63 per ton, and consumptive demand is normal.

ACID ACETIC has been in much better demand, price unchanged at £37 to £38 per ton for 80% grade.

ACID CITRIC is quiet, price unchanged at 1s. 7½d. per lb.

ACID FORMIC is in satisfactory inquiry and a fair business is passing. Price firm at £46 to £48 per ton for 85%.

ACID LACTIC is quietly steady at £43 per ton for 50% by weight.

ACID OXALIC is only in moderate demand, price unchanged at about £28 per ton.

ACID TARTARIC is firm and maker's prices are about 1s. 5d. per lb., although secondhand parcels are obtainable at a lower figure.

ALUMINA SULPHATE.—Unchanged at about £6 per ton for 17-18%.

AMMONIUM CHLORIDE is quietly steady at £19 per ton.

ARSENIC.—Unchanged.

BARIUM CHLORIDE.—A fair number of orders are passing, but the tonnage is small. Price about £9 per ton for spot delivery.

COPPER SULPHATE is quiet at £23 10s. per ton.

CREAM OF TARTAR.—The first hand market is very firm at an average price of about £100 per ton, but the secondhand realisations are cheaper.

EPSOM SALTS.—Unchanged at £5 5s. per ton.

FORMALDEHYDE has been in steady demand at about £41 10s. per ton.

LEAD ACETATE.—Unchanged at £42 to £43 per ton.

LEAD NITRATE.—Unchanged at £38 to £39 per ton.

METHYL ACETONE is in fair inquiry at about £62 to £63 per ton for high grade material.

METHYL ALCOHOL.—Unchanged at £48 or £47 per ton.

POTASSIUM CHLORATE is a quiet market at 3¼d. per lb.

POTASSIUM PERMANGANATE is in moderate demand, price showing an upward tendency at about 7½d. per lb.

POTASSIUM PRUSSIATE is a little easier on continental offering at £64 to £65 per ton.

SODA ACETATE is quiet at £19 per ton.

SODA BICHROMATE.—Unchanged.

SODA HYPO.—Unchanged.

SODA NITRITE is in fair request at about £19 10s. per ton.

SODA PRUSSIATE is firm at 4¾d. to 4½d. per lb.

SODA SULPHIDE.—Unchanged.

ZINC SULPHATE.—Unchanged.

Coal Tar Products

The market values of coal tar products show no change from last week, and there is very little prompt business passing.

90's BENZOL is very plentiful, and is quoted at 1s. 3d. to 1s. 4d. per gallon, on rails, while the motor quality is worth about 1s. 2½d. per gallon.

PURE BENZOL is worth about 1s. 8d. to 1s. 9d. per gallon.

CREOSOTE OIL is slightly firmer for spot delivery, and is quoted at 7½d. per gallon, on rails, in the North, while the price in London is 8¾d. to 9d. per gallon.

CRESYLIC ACID is very steady, the pale quality, 97/99%, being very scarce. It is quoted at 2s. 1d. to 2s. 2d. per gallon on rails, while the dark quality, 95/97%, is worth about 1s. 10d. per gallon.

SOLVENT NAPHTHA has practically no sale, and is worth from 10d. to 11d. per gallon.

HEAVY NAPHTHA can be purchased at 11d. per gallon.

NAPHTHALENES.—For the 74/76 quality there is practically no demand, and it is quoted at about £6 to £6 10s. per ton, while the 76/78 quality can be bought at £8 to £8 10s. per ton.

PITCH.—There is no change to report.

Latest Oil Prices

LONDON, June 22.—LINSEED OIL, quiet and 2s. 6d. to 5s. lower. Spot, ex mill, £34; June, £32 10s.; July-August, £32 15s.; September-December, £33 5s. RAPE OIL slow. Crude extracted £43 10s.; technical refined, £45 10s. COTTON OIL quiet. Refined common edible, £42; Egyptian crude, £36; deodorised, £44. TURPENTINE dull and a further 6d. to 3d. per cwt. lower. American, spot, 38s. 6d.; July-December, 39s. 9d. per cwt.

HULL, June 22.—LINSEED OIL was quiet. Naked, spot, June, July-August, and September-December, £33 10s. COTTON OIL steady. Spot, Egyptian crude, £35 10s.; edible refined, £39; technical, £38; and deodorised, £41. PALM KERNEL OIL.—Crushed, naked, 5¼ per cent., £37 5s. GROUNDNUT OIL.—Crushed/extracted, £44; deodorised, £48. SOYA OIL.—Extracted and crushed, £33 5s.; deodorised, £36 15s. RAPE OIL.—Crushed-extracted, £44; refined, £46. CASTOR OIL and COD OIL quiet and unaltered.

Nitrogen Products

Export.—As anticipated in our last issue the tendency of the sulphate market has been downwards. During the last day or two sales have been made on the basis of £9 10s. per ton f.o.b. U.K. ports in single bags. It is understood that the Far East as well as Mediterranean countries are purchasing at about this price.

Home.—Buyers in some parts of the country report small sales for prompt delivery. Apparently sulphate of ammonia is being used later in the year than hitherto. Last season's price scale remains in force, and it is doubtful whether the expected drop will take place for July delivery. Judging from the price for the export markets, we are inclined to the opinion that the season's price scale will be fully £1 per ton lower than that of 1926-7.

Nitrate of Soda.—The nitrate market has continued active and sales f.a.s. are being made on the basis of 16s. 7d. to 16s. 9d. per metric quintal for prompt shipment, with slightly higher prices for later in the season. The aggregate sales, since free selling commenced, amount to 700,000 tons, but some of this has been for prompt requirements. Of course, the great bulk of these sales have been to the large buyers. We are inclined to the view that when the new prices for sulphate of ammonia are announced the nitrate market will sag. According to Messrs. Aikman, further oficinas are opening shortly, and the production will soon be well over 10,000 tons a month. The stock in Chile remains at just over one million tons.

Japanese Methanol and Ammonia Processes

A COMPOUND process for methanol which has an important relation to the solution of the fuel problem is said to have been completed by three experts, Messrs. Kitawaki, Shibata, and Yokoyama, of the Nitrogen Laboratory, under the control of the Ministry of Commerce and Industry. The laboratory has obtained a patent from the Government, but private companies will be allowed to work it. The Government holds the patent to preclude possible trouble between companies, but the right of using the patent is held by the companies. More than a dozen applications have been filed, and the Government has selected three companies, the Mitsui Bussan Kaisha, the Japan Oil, and the Japan Acetic Acid Co. The method is quite different from wood distillation. Oxidised carbon and hydrogen are chemically combined under high pressure and high temperature. The feature of the process is that the cost of production of a pure article of nearly 100 per cent. is said to be only 15 sen per pound, one-third the former cost. Further reduction is considered feasible. Ammonia synthesis based on the atmospheric nitrogen system also has been completed by the Ministry after a study of eight years at Atmospheric Nitrogen Institute. The Ministry decided to give the right of operation to Oriental Nitrogenous Fertiliser Co. This company is to be established jointly by the Mitsui Bussan Kaisha, the Mitsubishi Shoji Kaisha, the Sankyo Pharmaceutical Co., and the Japan Fertiliser Co. The right has not been allotted yet, owing to a dispute between these companies.

THE COURTAULD-HISPANA CO. of Barcelona has been authorised to manufacture and sell artificial silk in Spain. The message does not make it quite clear whether the new concern is to be an actual producer of yarn. So far the artificial silk industry has been little developed in Spain. There is only one works in full production, situated at Valdenonceda, though several works are said to be on the eve of completion.

MR. BENJAMIN TALBOT, deputy-chairman and managing director of the Cargo Fleet Iron Co. and South Durham Steel and Iron Co., Ltd., and several other iron and coal companies in the North-Eastern area, has been elected president of the National Federation of Iron and Steel Manufacturers for the year 1927-1928, in succession to Mr. H. C. Bond. Mr. E. J. Fox, the managing director of the Stanton Iron Works, has been elected an additional vice-president.

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE *by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.*

Glasgow, June 22, 1927.

DURING the past week business in the heavy chemical market has been rather more active, quite considerable inquiry going around both for home consumption and export. Prices notwithstanding show little or no change.

Industrial Chemicals

ACID ACETIC, 98/100%.—£55 to £67 per ton, according to quantity and packing, c.i.f. U.K. ports; 80% pure, £37 10s. per ton, ex wharf; 80% technical, £37 10s. per ton, ex wharf.

ACID BORIC.—Crystal, granulated or small flakes, £34 per ton. Powder, £36 per ton, packed in bags, carriage paid U.K. stations.

ACID CARBOLIC ICE CRYSTALS.—Quoted price unchanged at 8½d. per lb., f.o.b. U.K. ports, but little demand, and could probably be obtained for less.

ACID CITRIC, B.P. CRYSTALS.—Still in good demand and price unchanged at about 1s. 6½d. per lb., less 5%, ex store. Continental quoted 1s. 7d. per lb., less 5%, c.i.f. U.K. ports.

ACID HYDROCHLORIC.—Usual steady demand. Arsenical quality, 4s. 9d. per carboy. Dearsenicated quality, 6s. 3d. per carboy, ex works.

ACID NITRIC 80°.—Quoted £23 5s. per ton, ex station, full truck loads.

ACID OXALIC.—Still in good demand and price unchanged at 3d. per lb., ex store, spot delivery. Offered from the Continent at 2¾d. per lb., ex wharf.

ACID SULPHURIC, 144°.—£3 12s. 6d. per ton; 168°, £7 per ton, ex works, full truck loads. Dearsenicated quality, 20s. per ton more.

ACID TARTARIC B.P. CRYSTALS.—In good demand and price advanced to about 1s. 3¾d. per lb., less 5%, ex wharf.

ALUMINA SULPHATE, 17/18%, IRON FREE.—Spot material quoted £5 12s. 6d. per ton, ex store. On offer for early delivery at £5 5s. per ton, c.i.f. U.K. ports.

ALUM POTASH.—Lump quality on offer at £8 5s. per ton, c.i.f. U.K. ports. Crystalline powder, £8 7s. 6d. per ton, c.i.f. U.K. ports. Lump quality on spot quoted £9 2s. 6d. per ton, ex store.

AMMONIA ANHYDROUS.—Unchanged at about 9d. per lb., carriage paid, containers extra and returnable.

AMMONIA CARBONATE.—Lump, £37 per ton; powdered, £39 per ton, packed in 5 cwt. casks, delivered or f.o.b. U.K. ports.

AMMONIA LIQUID, 880°.—Unchanged at about 2½d. to 3d. per lb., delivered according to quantity.

AMMONIA MURIATE.—Grey galvanisers' crystals of English manufacture quoted £23 to £24 per ton, ex station. Continental material on offer at about £19 15s. per ton, c.i.f. U.K. ports. Fine white crystals quoted £18 per ton, c.i.f. U.K. ports.

ARSENIC, WHITE POWDERED.—Spot material unchanged at about £18 15s. per ton, ex store. Offered for prompt despatch from mines at £17 10s. per ton, ex wharf.

BARIUM CARBONATE, 98/100%.—White powdered quality quoted £6 15s. per ton, c.i.f. U.K. ports.

BARIUM CHLORIDE, 98/100%.—Large white crystals quoted £7 7s. 6d. per ton, c.i.f. U.K. ports, packed in casks. Bags, 5s. per ton less. Spot material now quoted £9 per ton, ex store.

BARYTES.—English material unchanged at £5 5s. per ton, ex works. Continental quoted £5 per ton, c.i.f. U.K. ports.

BLEACHING POWDER.—Contract price to consumers, £8 per ton, ex station, minimum 4-ton lots. Spot material, 10s. per ton extra. Continental on offer at £7 12s. 6d. per ton, c.i.f. U.K. ports.

BORAX.—Granulated, £19 10s. per ton; crystals, £20 per ton; powder, £21 per ton, carriage paid U.K. ports.

CALCIUM CHLORIDE.—English manufacturers' price unchanged at £5 to £5 5s. per ton, ex station, with a slight concession for contracts. Continental dearer at about £3 12s. 6d. per ton, c.i.f. U.K. ports.

COPPERAS, GREEN.—Unchanged at about £3 10s. per ton, f.o.r. works, or £4 12s. 6d. per ton, f.o.b. U.K. ports, for export.

COPPER SULPHATE.—Continental material higher at about £25 7s. 6d. per ton, c.i.f. U.K. ports. British material on offer at about £25 per ton, f.o.b. nearest port.

FORMALDEHYDE, 40%.—Unchanged at £38 per ton, c.i.f. U.K. ports, spot material quoted £39 5s. per ton, ex store.

GLAUBER SALTS.—English material unchanged at £4 per ton, ex store or station. Continental quoted £2 15s. per ton, c.i.f. U.K. ports.

LEAD, RED.—Imported material quoted £33 per ton, ex store.

LEAD, WHITE.—About £33 5s. per ton, ex store.

LEAD ACETATE.—White crystals offered from the Continent at £42 7s. 6d. per ton, c.i.f. U.K. ports; brown, about £40 5s. per ton, c.i.f. U.K. ports; white crystals offered on spot at about £43 15s. per ton, ex store.

MAGNESITE, GROUND CALCINED.—Quoted £8 10s. per ton, ex store, in moderate demand.

POTASH CAUSTIC, 88/92%.—Solid quality quoted £28 15s. per ton, c.i.f. U.K. ports, minimum 15-ton lots. Under 15-ton lots, £29 10s. per ton. Liquid, £15 per ton, minimum 15-ton lots. Under 15-ton lots, £15 7s. 6d. per ton, c.i.f. U.K. ports.

POTASSIUM BICHROMATE.—Unchanged at 4½d. per lb., delivered.

POTASSIUM CARBONATE, 96/98%.—Quoted £27 5s. per ton, ex wharf, early shipment. Spot material on offer at about £28 10s. per ton, ex store.

POTASSIUM CHLORATE.—Powdered quality on offer at £24 5s. per ton, c.i.f. U.K. ports. Crystals, £2 per ton extra.

POTASSIUM NITRATE.—Refined granulated quality quoted £20 12s. 6d. per ton, c.i.f. U.K. ports. Spot material on offer at about £21 10s. per ton, ex store.

POTASSIUM PERMANGANATE, B.P. CRYSTALS.—Quoted 6½d. per lb., ex store, spot delivery.

POTASSIUM PRUSSIATE (YELLOW).—In good demand and price unchanged at about 7½d. per lb., ex store, spot delivery. Offered for shipment at 7¼d. per lb., c.i.f. U.K. ports.

SODA CAUSTIC.—Powder, 99/99%, £19 7s. 6d. per ton; 76/77%, £15 10s. per ton; 70/72%, £14 10s. per ton, carriage paid station, minimum 4-ton lots on contract. Spot material, 10s. per ton extra.

SODIUM ACETATE.—English material quoted £22 per ton, ex store. Continental rather higher at about £17 17s. 6d. per ton, c.i.f. U.K. ports.

SODIUM BICARBONATE.—Refined recrystallised quality, £10 10s. per ton, ex quay or station. M.W. quality, 30s. per ton less.

SODIUM BICHROMATE.—Quoted 3¾d. per lb., delivered buyers' works.

SODIUM CARBONATE (SODA CRYSTALS).—£5 to £5 5s. per ton, ex quay or station; powder or pea quality, £1 7s. 6d. per ton; alkali, 58%, £8 12s. 3d. per ton, ex quay or station.

SODIUM HYPOSULPHITE.—Large crystals of Engish manufacture quoted £9 10s. per ton, ex store, minimum 4-ton lots. Continental on offer at about £8 2s. 6d. per ton, ex wharf, prompt shipment. Pea crystals of British manufacture quoted £15 5s. per ton, ex station, 4 ton lots.

SODIUM NITRATE.—Ordinary quality quoted £13 per ton, ex store; refined quality, 5s. per ton extra.

SODIUM NITRITE, 100%.—Quoted £19 15s. per ton, ex store.

SODIUM PRUSSIATE (YELLOW).—Offered for prompt shipment from the Continent at 4¼d. per lb., ex wharf, spot material on offer at 4¼d. per lb., ex store.

SODIUM SULPHATE (SALTCAKE).—Price for home consumption, £3 7s. 6d. per ton, ex works.

SODIUM SULPHIDE,—60/65%. Solid, £11 10s. per ton; broken, £12 10s. per ton; cakes, £12 10s. per ton; flake, £14 5s. per ton; crystals, 31/34%, £7 15s. to £8 10s. per ton, according to quality, delivered buyers' works, minimum 4-ton lots on contract. Prices for spot delivery are 5s. and 2s. 6d. per ton extra for solid and crystals respectively. Offered from the Continent at about £9 7s. 6d. per ton, c.i.f. U.K. ports. Broken, 15s. per ton extra.

SULPHATE.—Continental material on offer at about £10 10s. per ton, ex wharf.

SULPHUR.—Flowers, £12 10s. per ton; roll, £11 per ton; rock, £11 per ton; floristella, £10 per ton; ground American, £9 5s. per ton, ex store. Prices nominal.

ZINC CHLORIDE.—British material, 98/100%, quoted £24 15s. per ton, f.o.b. U.K. ports; 98/100%, solid, on offer from the Continent at about £21 15s. per ton, c.i.f. U.K. ports; powdered, 20s. per ton extra.

NOTE.—The above prices are for bulk business and are not to be taken as applicable to small parcels.

Award of American Medal

MR. HARRY W. HARDINGE, of New York, a member of the Hardinge Co., has received the Edward Longstreth Medal of the Franklin Institute of Philadelphia, for his invention of the "Hardinge Air Classifier." In the statement of award it is remarked that "the chief functions of this device are to classify the ground material coming from a Hardinge or other type of tube mill, to deliver a more uniformly sized product to the collector and to return to the mill, for regrinding, all over-size material above a certain degree of fineness. This material is returned by means of a stream of air entering the mill at the delivery end and travelling in the opposite direction to the stream of air."

Manchester Chemical Market

(From Our Own Correspondent.)

Manchester, June 23, 1927.

The chemical market here has about fully recovered from the holiday disruption, with current business about equal in volume to what it was prior to the Whitsuntide stoppage. A quiet steady trade is being done and home trade consumers, particularly in the textile industries, are showing no anxiety to increase their commitments. Demand for export remains on much the same level as it has been during the past month or so.

Heavy Chemicals

The price position of prussiate of soda has not altered, and offers are still on the basis of 4¼d. per lb., a moderate inquiry being reported. Phosphate of soda is not attracting a great deal of interest, and values are on the easy side at £12 10s. to £12 15s. per ton. Chlorate of soda is selling quietly at about 2¾d. per lb. Bicarbonate of soda continues steady at about £10 10s. per ton, and the demand in this section is not unsatisfactory. Bichromate of soda is about unchanged on the week at 3d. to 3⅛d. per lb., and a moderate amount of business is being done. Sulphide of sodium meets with a quite demand, and the tendency of prices is easy, with 60-65 per cent. concentrated solid on offer at £11 10s. per ton and commercial quality quoted at round £8 10s. Bleaching powder continues to be offered at about £8 per ton, and a quiet trade is being put through at this figure. Inquiry for hyposulphite of soda is rather restricted, but there has not been much change during the past week in quotations, photographic being quoted at £15 5s. to £15 10s. per ton, and commercial at about £9 10s. Caustic soda is fully maintained, and a fair business is being done, current values ranging from £14 10s. to £16 10s. per ton, according to quality. There is not much inquiry just now in either saltcake or glauber salts, and offers of these at £3 12s. 6d. and £3 7s. 6d. per ton, respectively, are on much the same bases as before. Alkali keeps steady and meets with a fairly regular demand at about £6 15s. per ton. In the case of nitrite of soda demand is still rather quiet, but values remain at round £19 per ton.

Quotations for yellow prussiate of potash have an easy tendency, although, perhaps, they have not actually changed much since last week; a quiet trade is being done at about 7½d. per lb. Bichromate of potash is maintained at from 4d. to 4¼d. per lb., and meets with a moderate demand. Permanganate of potash is on the slow side, but prices are steady at 6½d. per lb. for B.P. and 5½d. for the commercial. Caustic potash is well held at from £29 to £30 10s. per ton, according to quantity, and inquiry for this material is of fair extent. Chlorate of potash is in limited request, and values are easy at about 3½d. per lb. For carbonate of potash there is a fair amount of inquiry about at £27 to £27 5s. per ton.

Sulphate of copper keeps steady, and a fair trade on export account is still being done; current prices are in the neighbourhood of £25 10s. per ton, f.o.b. Arsenic has shown further easiness, and the demand is relatively slow; from £15 10s. to £15 15s. per ton at the mines is now being asked for white powdered, Cornish makes. Acetate of lime is steadier in tone, although the demand in this section is still quiet; brown is on offer at £8 5s. per ton and grey at £15 10s. Except that nitrate of lead has firmed up a little there is not much change in the position of the lead compounds, brown acetate being quoted at about £41 per ton and white at £43 10s., while nitrate ranges from £38 5s. to £38 10s. per ton.

Acids and Tar Products

The demand for oxalic acid is still on a restricted scale, but values are fairly steady at round 3d. per lb. Tartaric acid is fully maintained at 1s. 3d. per lb., and a fair amount of inquiry is being met with. Citric acid is also in moderate request at about 1s. 6¼d. per lb. Acetic acid is well held at recent rates, and a steady business has been reported; commercial quality is quoted at about £37 per ton, and glacial at £66 10s.

Among the coal tar products solvent naphtha remains dull and inactive, and prices are weak at 1s. 2d. per gallon, delivered. Creosote oil, however, is maintained at 7½d. to 7¾d. per gallon, and inquiry for this is fairly brisk. Pitch is rather firmer on scarcity of spot parcels, round £4 2s. 6d. per ton being quoted here to-day. Carbolic acid is quiet, but unchanged at 8d. to 8¼d. per lb. for crystal and 2s. 4d. per gallon for the crude material.

Britain's Record Fair

Future of Gigantic Trade Show Assured

The holding of the British Industries Fair is definitely assured for the next three years, the British Government having leased the White City, Shepherd's Bush, for the London section of the Fair for the necessary periods in 1928, 1929, and 1930. The next Fair, which will be held simultaneously in London and Birmingham from February 20 to March 2, will be by far the largest British Industries Fair on record. The available exhibition area in London exceeds the space provided there last year by 100,000 square feet. Extensions amounting to 80,000 square feet are to be made at Castle Bromwich, Birmingham, and additional space up to 100,000 square feet is in readiness. Application forms for space in London are being sent out this week by the Department of Overseas Trade to approximately 10,000 British manufacturers. The space already applied for in the Birmingham section amounts to double the figure for the corresponding day last year.

Royal Photographic Society Exhibition

The Royal Photographic Society of Great Britain will hold its 72nd annual exhibition in September and October next. This is described as the most representative exhibition of photographic work in the world, and comprises all the recent achievements of photography, both pure and applied. It is desired to make the Scientific and Technical Section as representative as possible, and with this end in view exhibits are invited of apparatus, models, prints, diagrams, transparencies, or any other form of record illustrating the applications of the photographic method to biology, botany, mineralogy, microscopy, geography, geology, spectroscopy, photometry, engineering, colorimetry, textiles, etc. Those who have material at their disposal suitable for exhibition are invited to send their exhibits before August 13, 1927, addressed to the Royal Photographic Society, 35, Russell Square, W.C.1.

A Guide to Railway Charges

Issued with May and Baker, Ltd.'s, new price list is a set of tables which should prove of great assistance to manufacturers, merchants, buyers, or to anyone who has to do with the transport of goods in bulk. These tables form a scale of standard charges of goods and minerals (except coal, coke, and patent fuel), sent by goods train, based on the schedule of standard charges provisionally fixed by the Railway Rates Tribunal, December, 1926. The rates are applicable to the G.W., L.M. & S., L. & N.E., and Southern railways.

The new list issued by May and Baker, Ltd., employing a cross reference system, is a well-arranged catalogue composed of a general list including general chemicals, aniline dyes, organotherapeutic compounds, stains, sugar, and reagents for bacteriology, and sections devoted to pharmaceutical specialities, drugs and hypodermic ampoules. At the end of the volume is a useful list of synonyms and trade names, English and metric equivalents, specific and atomic weights.

Nitrophoska for U.S. Cotton Fields

The I.G. is preparing to sell in the United States a type of the mixed fertiliser Nitrophoska, which it is specially blending to suit the cotton fields of the South. The American Customs authorities have granted the fertiliser exemption from import duty. Nitrophoska was only put on the German market in 1926, and the demand for it from the farmers has exceeded the possible output. It is a combination of nitrogen, phosphoric acid, and potash, and was designed especially to meet average European needs. The manufacture of a blend suitable to American cotton fields is a continuation of the policy that the I.G. has adopted. Already the I.G. are manufacturing Leunaphoska, a fertiliser specially adapted to China, and they hope in the future to provide blends for the chief agricultural districts in the world.

Company News

BRITISH DRUG HOUSES, LTD.—The usual quarterly dividend of 1¼ per cent. on the preference shares will be paid on June 30.

BROUGHTON COPPER CO.—The net profits for the past year were £41,068. A final dividend of 10 per cent. is proposed, making 15 per cent. for the twelve months.

CYPRUS ASBESTOS CO., LTD.—The directors state, in their report for the year ended December 31 last, that as a result of the year's working the debit balance at profit and loss account has been reduced from £27,697 to £2,017.

AMERICAN CYANAMID CO.—The usual quarterly dividend of 1¼ per cent. has been declared on the preferred stock and a dividend of 1½ per cent. plus ½ per cent. extra has been declared on the common stock, payable on June 15.

IPSWICH BEET SUGAR FACTORY.—The third report of the Ipswich Beet Sugar Factory states that profit in trading was £287,232, of which £96,112 is set aside for depreciation and £67,391 put to reserve. A dividend of 12½ per cent., free of tax, is declared.

ABERTHAW AND BRISTOL CHANNEL PORTLAND CEMENT.—For the year ended March 31 last, the report states that the profits were £75,069, making, with the balance brought forward, £147,782 available. A final dividend is recommended on the ordinary shares of 9 per cent., making 15 per cent., less tax, for the year, carrying forward £74,032.

BELL'S UNITED ASBESTOS CO., LTD.—The directors inform us that the offer by the company to shareholders and employees of 140,000 6½ per cent. preference and 56,468 ordinary shares has been subscribed several times over by the shareholders. Among the applications are over 500 from employees of the company. It is hoped to post letters of allotment and regret by Monday next, June 27.

ENGLISH BEET SUGAR CORPORATION.—The report for the year ended March 31 states that the factory at Cantley worked during the year 161,841 tons of beet and 22,712 tons were sent to associated factories for working. Contracts were made with 2,936 growers for 21,820 acres of sugar beet. The trading profit for the period was £306,949. After providing for all charges, income-tax, and depreciation, and transferring £156,067 to general reserve, there is a net profit of £90,101. The directors recommend a dividend of 20 per cent., free of tax, on both the cumulative preference and ordinary shares.

PINCHIN, JOHNSON AND CO.—At an extraordinary general meeting on Wednesday, called to authorise an increase in capital of the company by the creation of 250,000 ordinary shares of £1 each, it was disclosed that part of the new capital was required to acquire the business of the Red Hand Compositions, Ltd., an old-established and successful company in the ships' bottom and anti-fouling composition section of the paint trade. The business of the Red Hand company will continue to operate as a separate trading unit under the present management, and backed by the resources of Pinchin, Johnson it is not unreasonable to expect that it will enjoy an increasing measure of success. The chairman intimated that to date this year all units of the business show most satisfactory expansion.

Tariff Changes

DOMINICA.—The Dangerous Drugs Ordinance, 1927, prescribes revised provisions for regulating the importation, exportation, manufacture, sale, and use of opium and other dangerous drugs. The text of the Ordinance may be seen on application to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

HUNGARY.—In virtue of a recent Decree the import duty has been temporarily suspended or modified with regard to certain classes of goods, including acetone for the manufacture of cellulose varnish, palm oil for the manufacture of stearin and elain, sulphate lye for metal foundries and cable factories. Half the normal duty is payable on dyed artificial silk.

CANADA.—Ethylene glycol, when for use in Canadian manufactures until the end of the next session of Parliament, is, under a recent Order in Council, transferred to the list of goods which may be imported into Canada free of Customs duty.

New Chemical Trade Mar!

Applications for Registration

This list has been specially compiled for us by Gee & Co., Patent and Trade Mark Agents, Staple House, 51 and 52, Chancery Lane, London, W.C.2, from whom further information may be obtained, and to whom we have arranged to refer any inquiries relating to Patents, Trade Marks and Designs.

Opposition to the Registration of the following Trade Marks can be lodged up to July 8, 1927.

"PRESTAINION."

479,938. Class 1. Wood preservatives and wood stains. The firm trading as Frederick Baldwin, Static Yard, Devons Road, Violet Road, London, E.3; coal and by-products merchants. April 21, 1927.

"ORIELITE."

479,519. Class 1. Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives, but not including varnishes, and not including any goods of a like kind to varnishes. A. W. Prentice and Co., Ltd., Oriel Paint and Varnish Works, Oriel Street, Vauxhall Road, Liverpool, Lancashire; manufacturers. April 6, 1927.

"TWO SPIRE BRAND."

479,886. Class 1. Zinc oxide. Zinc Oxides, Ltd., Albert Chambers, 26, High Street, Cardiff; manufacturers. April 19, 1927.

Opposition to the Registration of the following Trade Marks can be lodged up to July 15, 1927.

"STEPPOL."

477,358.—Class 1. Paints and distempers. Reckitt and Sons, Ltd., Kingston Starch Works, Dansom Lane, Hull, Yorkshire; manufacturers. February 2, 1927. (To be Associated. Sect. 24.) (By Consent.)

"FACTOTUM."

478,866. Class 1. Paints, enamels, varnishes and wood preservative solutions. Metalpaint, Ltd., Carlton House, Regent Street, London, S.W.1; paint manufacturers. March 16, 1927.

"PASTERLAC."

480,254. Class 1. Paints, varnishes, enamels, dry colours, distempers, japans, lacquers, anti-corrosive and anti-fouling compositions and anti-corrosive oils. Arthur Holden and Sons, Ltd., 218 and 219, Bradford Street, Birmingham; manufacturers. May 3, 1927.

"FALVA."

480,310. Class 1. Paints, varnishes, enamels, dry colours, distempers, japans, lacquers, anti-corrosive and anti-fouling compositions and anti-corrosive oils. Pinchin, Johnson and Co., Ltd., General Buildings, Aldwych, London, W.C.2; varnish, colour, and paint manufacturers. May 4, 1927.

"NAPHACID."

480,645. Class 1. Chemical substances used in manufactures, photography, or philosophical research, and anti-corrosives. Sterns, Ltd., 16, Finsbury Square, London, E.C.2; oil refiners, grease and lubricator manufacturers. May 13, 1927.

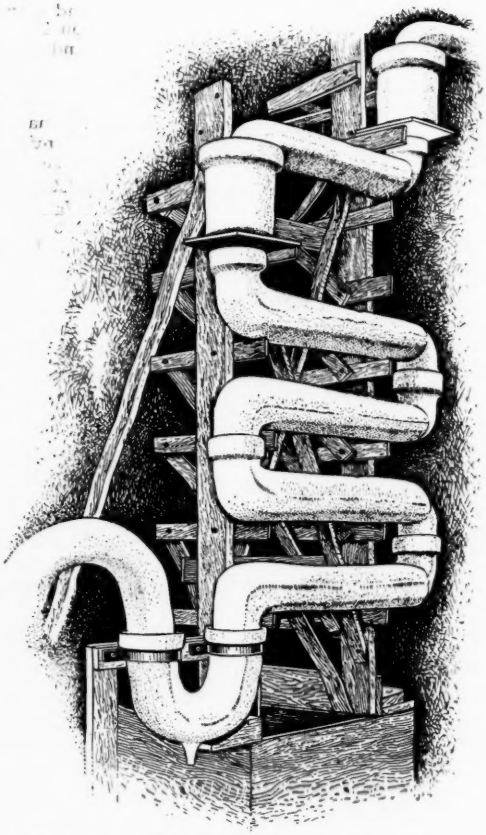
Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

PAINTS.—The Director-General, India Store Department, Branch No. 10, Belvedere Road, London, S.E.1, invites tenders for 68 lots paints, zinc, lead and various, ground and mixed. Tenders due July 5. Specifications and forms of tender obtainable from the above at a fee of 5s. per set.

DRUGS, ETC.—The Head Direction of Public Health at Sofia is calling for tenders to be presented by July 3, for the supply of drugs, disinfectants, etc. (Reference B.X. 3,586.)

The "VITREOSIL"



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Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

AYRE (FRANK A.) AND CO., LTD., Newport (Mon.), paint manufacturers. (M., 25/6/27.) Registered June 7, debenture to Bank; charged on Ayres Paint Works, Tregare Street, Newport (Mon.), also general charge. *Nil. December 31, 1926.

CORBYN STACEY AND CO., LTD., London, E., chemists. (M., 25/6/27.) Registered June 7, £850 debenture, to W. H. Robertson, Southbeech, Waldegrave Road, Bickley; general charge (subject to prior debentures). *£7,000. April 9, 1926.

LANCEGAYE AND CO., LTD., Mitcham, paint manufacturers. (M., 25/6/27.) Registered June 9, £800 debenture to Alexa Farr, 12, Gloucester Square, W.; general charge. *£701. January 5, 1927.

LEE AND POLLARD, LTD., Sutton-in-Ashfield, dyers and finishers. (M., 25/6/27.) Registered June 8, charge, to Bank; charged on properties in Bishop Street and Edwin Street, Sutton-in-Ashfield. *Nil. December 31, 1926.

STANDARD SOAP CO., LTD., Ashby-de-la-Zouch. (M., 25/6/27.) Registered June 8, £9,000 debenture, to R. Dobson and another, Mosley Street, Manchester; general charge (subject to prior debenture). *£12,500. January 12, 1927.

WILLOWS, FRANCIS, BUTLER AND THOMPSON, LTD., London, E., druggists. (M., 25/6/27.) Registered June 9, charge, to Bank; charged on 89a, 73 and 75, Shacklewell Lane, Dalston. *£9,500 and overdraft up to £3,000. August 12, 1926.

London Gazette, &c.

Company Winding Up Voluntarily

SOUTH AFRICAN CARBIDE AND BY-PRODUCTS CO., LTD. (C.W.U.V., 25/6/27.) By special resolution, May 26, confirmed June 15, T. Ogden, 32, Victoria Street, Westminster, chartered accountant, appointed liquidator. Meeting of creditors at liquidator's office, Monday, July 4, at 12 noon.

Notice of Dividend

PICKLES, Robert Henry, Prussiate Works (also known as Manganese Mills), Droylsden, Manchester, trading as R. H. PICKLES AND CO., chemical manufacturer. First and final dividend, 4s. 8d. per £, payable July 8, 27, Brazennose Street, Manchester.

New Companies Registered

ANTIMONY PRODUCTS AND CHEMICAL CO., LTD., Croydon Road, Elmers End, Beckenham, Kent. Registered June 17. Nom. capital, £10,000 in £1 shares. To adopt agreements with H. E. King, W. J. Knight Chandler, and A. P. King, and to carry on the business of chemical manufacturers, wholesale druggists, drug grinders, importers and exporters, manufacturers of pharmaceutical, medicinal, and chemical preparations, etc. Directors: A. P. King, W. J. K. Chandler.

BROCKBANK AND POWELL, LTD., Palace Chambers, Bridge Street, Westminster, London, S.W.1. Registered June 15. Nom. capital, £2,100 in 2,000 5 per cent. non-cumulative preference shares of £1 each and 2,000 ordinary shares of 1s. each. Importers, exporters, consulting and general engineers, mechanical, metallurgical, electro-metallurgical and electrical engineers, etc. Directors: C. J. Brockbank and H. H. Powell.

BURROS PAINTS, LTD.—Registered June 21. Nom. capital, £100 in £1 shares. Manufacturers of paints, varnishes, enamels, distempers, etc., now carried on by E. C. Burroughs as "Burroughs and Co." at City Mills, High Street, Stratford. Directors: A. F. Nutting, 106, Sutherland Avenue, London, W.9, and E. C. Burroughs.

SULFUROPHOSPHATE, LTD. Registered June 17. Nom. capital, £3,000 in 1,000 preference and 1,900 ordinary shares of £1 each and 2,000 founders' shares of 1s. each. To acquire a licence for the manufacture of sulfurophosphate in Great Britain and to carry on the business of manufacturers and distributors of manures and general fertiliser products, including the fertiliser known as "Sulfurophosphate," etc. A director: C. E. Roudolphi, 59, Christchurch Road, Streatham Hill, London, S.W.2.

Helium in Canada

THE Mines Branch of the Canadian Department of Mines has issued a monograph on "Helium in Canada," by R. T. Elworthy (Ottawa: F. A. Acland, pp. 64, 20 cents). It is stated in the introduction that the investigation, carried out under Professor J. C. McLellan, has shown that available supplies of helium in Canada are insufficient to furnish the great volumes of the gas that would be necessary to supply the commercial airships of five and six million cubic feet capacity that are now under construction in Great Britain. The National Research Council of Canada has under consideration the question of whether other possible uses are of sufficient importance to warrant the extraction of smaller amounts of Canadian helium. In the present monograph the subject-matter is arranged under the following headings: Helium and its properties; resources of helium in other countries; the investigation of the helium resources in Canada; the natural gas fields of Canada and the helium content of gases; bibliography of natural gas in Canada; technology of helium; bibliography of helium resources and production. There are two excellent maps, showing the natural gas resources of Alberta and the gas and oil fields and pipe lines in south western Ontario respectively. Special interests attaches to the question of the cost of extracting helium. To-day the lowest cost per thousand cubic feet that has been obtained in the United States helium extraction plant at Fort Worth, Texas, is $24, or 2·4 cents per cubic foot. From the operation of the small-scale experimental plant in Calgary in 1919–20, Professor J. C. McLellan estimated that helium could be produced on a commercial scale in the Bow Island field for $100 per 1,000 cubic feet.

Suggested New Work for Pharmacists

IMPORTANT changes in the training of pharmacists in order that they should be qualified to work as bacteriologists, pathologists, and X-ray operators, were advocated at the opening of the British Pharmaceutical Conference at Brighton, on Tuesday, by Dr. T. H. Burn, director of the society's pharmacological laboratory. There had, he said, been a great development of the methods of discovering the nature of disease and of curing disease during the past thirty years, but in many ways the practice of the general practitioner had not been altered to any great extent. A medical consultant often formed his opinion of the condition of a patient as the result of X-ray, blood, bacteriological, and perhaps other examinations. The general practitioner had none of these aids. Was there not there an opening for the pharmacist? All these examinations depended on the performance of tests which offered no more difficulties than did such chemical processes as the pharmacist at present learned. But if they were to be carried out so as to be of value they demanded a very thorough training. Then the Therapeutic Substances Act, which would be in force in two months' time, would have the effect that no one who had not proper facilities for carrying out sterility tests would be able to get a licence to interfere in the smallest way with the products referred to in the Act. Courses in bacteriology and pathology should be instituted and the use of X-ray apparatus should be taught. Men so trained would find their own openings. They could run a small testing department in connection with an ordinary retail business. It would be for the pharmacist to develop his own connection with the medical men in his neighbourhood, and those sufficiently trained should have a diploma from the society.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

What of 1927?—Retrospect and Prospect

THERE was a remarkable recovery in the China Clay trade at the year's end, for during December, in spite of the interval of the holidays, deliveries of China Clay reached the splendid total of 84,880 tons, only 2,636 tons below the record month of the year, namely July, when 87,516 tons were delivered. Having regard to the smaller number of working days in the month, the last month was a record.

It is interesting to note the fluctuations in trade in the latter part of the year. In October there was a drop of 20,000 tons following the collapse of the new Association scheme, but shortly after October it began to dawn on buyers, and especially those in America, that, despite the collapse, there was bound to be a rise in prices, especially of the best clays, in 1927, to meet the inroads made on reserves, financial and otherwise, that firms had suffered during the coal strike. Consequently foreign importers began in November to resume big shipments, which continued to the end of December, the end of year rush being due to the keenness of buyers to get through as much China Clay as possible at 1926 prices. This accounts for the abnormal shipments in December for, in the ordinary course, shipments are lower in that month than in other months of the year owing to holidays and climatic conditions.

Coal Strike Handicap

The industry did not feel the full effects of the coal strike until after June, when there began a considerable falling-off in the volume of trade compared with 1925, which came within three thousand tons of the pre-war "boom" year of the industry, 1912. As 1925 was over 50,000 tons above 1924, the industry hardly expected to maintain the same volume in 1926, having regard to the coal strike. The figures showing the total business done for the twelve months to the end of December in the three classes of products with which China Clay firms deal, namely, China Clay, Ball Clay, and China Stone, are much better than had been hoped for, the volume having reached the splendid total of 934,775 tons against 958,685 tons in 1925, a drop of 23,910 tons only. Of the three classes, China Clay shows a drop of 14,335 tons, China Stone showing an increase of 1,684 tons and Ball Clay a decrease of 500 tons. The biggest monthly drop was recorded in October, when the effect of the coal strike had reached its height, the decrease having been 20,000 tons in the three classes of products.

Foreign Trade Maintained

Having regard to all the circumstances, the industry considers itself fortunate in having survived the coal strike so well, the volume of trade for the whole year being in excess of that recorded in 1924, when a total of 901,000 tons was delivered. An encouraging feature of the world's trade has been the success with which the industry has maintained its overseas business, especially with its biggest market, the U.S.A., where 335,768 tons was exported to the end of November, the latest figures available at the time of writing. The shipments to the other chief importing countries for the same period were :—Germany, 23,510 ; Netherlands, 37,842 ; Belgium, 61,432 ; France, 26,599 ; Spain, 15,297 ; and Italy, 19,606 tons.

Grounds for Optimism

It is natural that the wish should be father to the thought in the prophecy of a bumper year for the China Clay industry in 1927, but there is something more substantial than that to justify the prediction. Having regard to the handicap of the coal stoppage in 1926, it was really a remarkable year, for the total tonnage was considerably in excess of that in 1924, when there were no disturbances of any magnitude, and round about 30,000 to 40,000 tons below the tonnage of 1925. The big falling off in the home market in 1926 was almost wholly responsible for this, the overseas trade having been fully maintained in the case of most importing countries, and even exceeded in others.

Seeing that this result was achieved in a year when the industry was subjected to the severe handicap referred to, it is reasonable to make the deduction, when anticipating future prospects, that with no such handicap and with a plentiful supply of cheap fuel, great progress will be made this year. The revival of our home industries, which are big consumers of China Clay—potteries, paper mills, chemical works, and cotton mills—must give a great fillip to the home demand for the product, the home markets having suffered most by the coal difficulty.

Continental Markets

The handicap of the fluctuating exchanges on the Continent that has operated against the steady development of business in European countries since the war, is now considerably lessened, and in some cases reduced to a minimum. The financial outlook on the Continent, especially in Germany, France, and Belgium, is better now than at any time since the war, the exchanges having improved to such an extent that it pays these countries better to buy more of their raw materials outside than it did previously. This should be a favourable factor in the development of bigger markets on the Continent this year.

Buoyant American Market

As for the American markets for China Clay (or kaolin, as American buyers call it), already enormous as they are, they are likely to continue to grow. It must be borne in mind that the demand for China Clay is not confined to the English product. It is a remarkable fact, encouraging to both American and English producers of China Clay, that the demand for American kaolin has increased in nearly the same ratio as has that for English China Clays, 1926 being no exception to other years since the war. There is nothing in the allegation that is sometimes made by American competitors that English producers are cutting the price below an economic level to capture the American domestic kaolin markets ; it is recognised that some domestic kaolins are more accessible to and suit some areas for certain purposes as well as does the English product, while there are other areas in the States where English China Clays are supreme. There is no reason why the consumption of both the domestic and imported China Clays should not continue to increase ; certainly it is some protection to the American consumer to feel that the competition between the producers of the two varieties

ensure for him the supply of his raw material at competitive prices without the imposition of tariffs, which only tend to make both dearer.

1926 Drain on Resources

Not the least regrettable feature of the effects of the coal strike is the severe drain it has had upon the financial resources of some concerns that were recovering their position on the eve of the coal stoppage. The natural consequence has been that works that were on the border line have had to close down, and others have had to restrict severely the number of their staffs and reduce labour costs. This has thrown upon the labour market an additional number of unemployed. With the improvement in the outlook it is hoped that these men will gradually be absorbed by the industry, as with the anticipated greater demand and the necessity for firms to make good their depleted stocks, there must be a greater demand for labour on the productive side. Following upon this there will be a revival of development work, which is the first to cease when economic conditions grow worse.

Rates Handicap

To assist the industry in the restoration of trade there must be encouragement from all sides. That is why we hope the local governing authorities, and especially the St. Austell Rural District Council, to whom the China Clay producers have appealed for stricter economy in local administration, will take note of the request made in the letter signed by all the biggest China Clay producers. After all, seeing that the industry is the biggest ratepayer in the China Clay district, it is entitled to be considered. Though the letter did not receive the consideration that might have been expected, it should influence the council in their future policy, especially as they will be shortly preparing their estimates of expenditure for the six months ending next September.

If all are prepared to pull together—China Clay landowners, producers, employees, and rating authorities—1927 should prove to be the best year the China Clay industry has ever experienced, not excluding the "boom" year of 1912, when approximately a million tons were delivered. Let the aim for 1927 be "Over the million mark"!

Colouring in Bone China Bodies

Some Recent Experiments

A NUMBER of experiments were made with different bodies composed of China Clay, bone ash, and Cornish stone in varying proportions. The bone ash and Cornish stone were ground with water and on evaporating the water used in the body slip hydrolysis occurred, resulting in a plastic product. The latter was cast into small cups or made into thin slips and fired in a china biscuit oven at Seger cone 9. The different products varied in colour, some being cream tinted and others either yellow, reddish-brown or a deep greenish-blue in a considerable variety of tints. Those exhibiting brown colours were mixtures composed of China Clay and bone ash, but containing no stone, whilst the products displaying a bluish-green colour were mixtures of 42 per cent. clay and 58 per cent. bone ash. On the other hand, in bodies composed of China Clay and Cornish stone the colour given was a yellowish-brown. In the case of mixtures of bone ash and Cornish stone the products displayed a pale colour, the darkest brown occurring when 42 per cent. ash and 58 per cent. stone were employed. Then, again, as the proportion of stone increased in mixtures where 58 per cent. China Clay was used, the shade of brown displayed became paler. Where 42 per cent. China Clay was employed the colours varied, according to the diminishing proportion of bone ash added, from green to bluish-green, yellow, and brown. The smaller the proportion of stone and the higher the percentage of clay used in the bone china bodies the greater was the tendency to develop blue ware. The latter, however, when glazed was liable to craze badly.

Effect of Other Factors

The bone china bodies did not mature by long storage. On keeping, the greenish-blue products turned into a reddish-brown. The effect of time on other samples of a low stone content was to render them brown. This was apparently caused by oxidation. A subsequent glost fire tended to clear the colours, but firing in an enamel kiln intensified them. In certain blue china samples where the stone was deficient in felspar brown stains of ferric phosphate occurred in the enamel kiln. On those products which were deficient in stone and gave greenish-blue and reddish-brown colours the glazes displayed a tendency to craze. On the other hand, when there was an excess of stone present the contraction of the bodies was high with a predisposition to develop blisters or "bloats." On examination under the microscope the foregoing samples displayed an outstanding proportion of glassy base containing clusters of crystallites, small angular fragments of quartz and comparatively large pores. On the other hand, there were no minerals having fully developed crystalline forms present. The origin of the brown colours of some of the samples seemed to be the presence of a clear brownish glass—unsystematically dispersed throughout the mass in all directions.

China Clay Firms' Rates

Their Effect on Employment

AT the meeting of the St. Austell Rural District Council, on January 7, the chairman, Mr. P. H. Rowe, presiding, the following letter from China Clay producers was read :—

"We, the undersigned China Clay producers, paying considerably more than one-half of the rates paid by the industry, desire to place on record the very heavy burden entailed by the enormous increase of rates, and to express the desire that your Council will make every endeavour to curtail expenditure, and also adopt such means that may be necessary to bring the rates down to nearly the same level as those existing in pre-war time. The latter suggestion may be impossible, but we consider it our duty to emphasise the burden which falls on this industry through the heavy local taxation. We are also strongly of the opinion that high rates create unemployment, where low rates tend to increase employment. We make this representation without wishing in any way to raise criticism, but simply in order that your authority may appreciate the true position. It is needless to call your attention to the fact that the R.D.C. rate has increased from 1s. 4d. in 1914 to 5s. 6d. for 1926."

The letter was signed by John Hooper (Anchor United China Clay Co., Ltd.); S. B. Perry (Burthy China Clays, Ltd.); R. Martin (English China Clays, Ltd.); E. J. Chivell (Gover China Clay Co., Ltd.); Hart Nicholls (Great Halviggan China Clay Co., Ltd.); Samuel J. Dyer (Great Treviscoe Clays, Ltd.); J. Lovering and Co.; T. Martin (Lower Lansalson and Caudledown China Clay Co., Ltd.); Wm. Luke (William Luke and Co.); Hart Nicholls (North Goonbarrow China Clay Co., Ltd.); F. Parkyn (Parkyn and Peters); H. D. McLaren (H. D. Pochin and Co., Ltd.).

After Mr. W. H. Body had remarked that the letter ought to have been sent to the County Council rather than that Council the matter was dropped, but later in the meeting another councillor, Mr. R. Varcoe, said he thought the Council should reply to the letter in a suitable and courteous manner. They were in sympathy with the letter and they should reply that the rates would be kept as low as possible. The Council agreed with a suggestion of the chairman that the letter be acknowledged.

St. Austell Sunday Golf

PROTESTS have been made by the religious community of St. Austell against the decision of the St. Austell Golf Club to allow golf to be played on their links on Sunday, and against the introduction of a drinking bar. The Club have now purchased the course, with additional land, and the lay-out has recently been inspected by Mr. James Braid, the veteran professional. Mr. John Lovering is the president of the club.

China Clay Notes and News

Unemployment in Mid and West Cornwall

The Mid and West Cornwall unemployment returns in the first week in January were: Redruth, 345; Camborne, 401; Falmouth, 980; Fowey, 118; Hayle, 246; Helston, 68; Newquay, 37; Penzance, 369; Perranporth, 8; St. Austell, 553; St. Columb, 103; St. Just, 97; Truro, 174. Of the above numbers 514 men, 5 boys, 71 women and 6 girls are known to be working short time, or stood off temporarily, or in casual employment.

China Clay Director's Death

The death occurred recently at Cardrew Terrace, Redruth, after a short illness, of Mr. William Born, aged 71, and late of Belmont, Ladock. Deceased was formerly a local preacher with the then Bible Christian denomination, and at the time of his death he was a director of the St. Dennis and Parkandillick China Clay Co., St. Austell. The interment took place at Redruth Cemetery. Those present included Messrs. R. J. Varcoe, F. J. Best and R. Varcoe (fellow directors of the above China Clay company).

China Clay Droppings Cause Trouble

During damp weather the streets in St. Austell get in a very treacherous state owing to the coating of slippery mud. On one or two days recently heavy solid-tyred lorries passing through Fore Street found great difficulty in keeping a straight course. In one or two cases sacks had to be put down to enable the back wheels of vehicles to be brought out of the water-table. The roads used by clay traffic became dangerous in places—on the main Bodmin Road to Bugle, to mention only one instance. The slippery condition of the roads in wet weather is very much contributed to by the dropping of clay from wagons and lorries and is a cause of a good deal of dust in dry weather. If carriers were a little more careful in the loading of their wagons the trouble might be lessened.

Big Fireclay Profit Despite Coal Strike

At the annual general meeting of the Glenboig Union Fireclay Co., the chairman declared that, but for the coal stoppage, the company would have had one of the most prosperous years it had ever had. There was plenty of work for employees—overtime, in fact—and the works were exceptionally busy when they had to cease through want of coal. At present they were able only to produce a very limited output for essential purposes. If they got coal now they were in a satisfactory position to take advantage of any expansion of trade. The order-book was in a healthy condition. The balance sheet figures showed a shrinkage, but that was natural when they considered that it represented eight months' work only. A dividend of 17½ per cent. was declared.

St. Austell Bank Manager's Death

St. Austell people were much shocked on the eve of the Christmas festivities to learn of the death of Mr. Harry Seed, manager of the Midland Bank, St. Austell, who had a sudden seizure. Mr. Seed came to St. Austell from Liverpool in September, 1921, to open the new branch of the Midland Bank at St. Austell as manager. He had served in the war in France, having joined up in August, 1914, in the 7th Batt. King's Own Regiment (Lancaster). He was wounded and was invalided out in March, 1918, with the rank of lieutenant. The rigours of service left their mark upon his constitution, necessitating his taking things steadily, though his health was not such as to require any prolonged absence from business until the day before he died. Mr. Seed, who was aged 45, leaves a widow and three children.

Clayopolis to be Wood Paved

An important recommendation which will be welcomed by the long-suffering users of St. Austell Fore Street was that made at the last St. Austell Urban Council meeting by the Highways and Sanitary Committee for the acceptance of the Surveyor's scheme for wood paving, subject to the approval of the Ministry of Transport, who are expected to make a grant towards the cost. Mr. T. J. Smith, chairman of the committee, said the committee were convinced that with the heavy motor traffic that now passed over the road, it was impossible to maintain a satisfactory road on the old stone macadam system. The council felt that all the criticisms they were continually receiving from the ratepayers were justified, and they were doing their best to meet the situation. He believed every member was anxious to see Fore Street put in a fit condition. The Council unanimously endorsed the report.

A Hint from America

The following paragraph in the December issue of the *Paper Trade Journal*, published in New York, relating to the prices being quoted by importers for English China Clays on the ground of increased cost of production through coal difficulties, should stiffen the backs of home producers of China Clay before entering into contracts for next year at this year's prices, as some producers are reported to have been invited to do.

The paragraph reads as follows:—"The spot price of English China Clay, including both filler and coating clays, has advanced about two dollars per ton. The additional costs, according to importers, are due to the higher prices and scarcity of coal in England. 'Contracts are being undertaken for 1927 delivery at from 13 to 25 dollars per ton in bulk, ships side. Domestic washed clay is still selling at from 8 to 9 dollars per ton at mine, and pulverised at 10 dollars per ton. As an increase of two dollars per ton [8s. 4d.] is a good deal in excess of what home producers have been able to get American buyers to rise to to meet the increased costs of production, they should not be too eager to enter into contracts for next year at prices that do not give them a fair share of the increase American importers are quoting their customers on 1927 contracts."

Cornwall's New Harbour Extension

At their last meeting a committee of the Cornwall County Council received from Port Isaac Harbour Commissioners the copy of a letter from the Treasury saying that the Development Commissioners recommend that an advance be made from the development fund to Port Isaac of such sums not exceeding £22,627 as might be required to meet two-thirds of the cost (estimated at £33,940) of carrying out the full scheme of harbour works described by Mr. Gedyes' report in April, 1925, subject to the condition that one-half of the advance from the Development Fund be granted and the other half deferred, the terms of repayment and interest to be considered in ten years' time.

The Bodmin Rural District Council had promised a loan of £5,000 and the district of Port Isaac had collected £1,200, so that they wanted about £5,000 to comply with the conditions laid down by the Treasury and the Board of Agriculture and Fisheries. Mr. S. T. Button proposed that the Committee recommend that the County Council make a grant of £2,500 and that they borrow the remainder of the money required on behalf of the Port Isaac Commissioners. Mr. R. Lean seconded. Mr. C. L. Fox moved as an amendment that a sub-committee be appointed to go to Port Isaac and get more information of financial and other details. Mr. H. Grylls seconded, and the amendment was carried. Mr. C. L. Fox, Colonel T. H. Cornish, and Mr. P. D. Williams were appointed to the sub-committee.

Mr. J. W. Higman on Industrial Organisation

The Cornwall Branch of the Bank Officers' Guild met at the White Hart Hotel, St. Austell, last month, when a gathering of 60 members, including 20 from St. Austell, met to hear an address by Mr. A. O. Kernick, of Lloyd's Bank, Ashburton, a member of the National Executive. Arrangements were made by the Cornwall Branch of the Guild, which is now 250 strong. Mr. Bush is the chairman, Mr. W. R. Hooper, Redruth, vice-chairman, and Mr R. F. Smale, St. Austell, hon. treasurer.

Mr. J. W. Higman, J.P., presided, and after referring to the objects of the meeting, which he understood was to strengthen organisation among themselves, he said he had had a good deal to do with organisation as chairman of the

China Clay trade organisation when it was formed, and he had attended many meetings in London of their own and other trades. There was nothing like organisation to-day. Individual efforts were useless, and if they had no organisation it was right for them to get one. Labour had just as much right to organise as the employers had. As far as the China Clay industry was concerned, they had always got on very well indeed with the Workers' Union. Later in the evening Mr. Higman commended the efforts of the Guild, and after referring to the great strike of 1913 in the China Clay works, said that that really marked the beginning of the Whitley Council in their industry. They had had many difficulties, but they had all been settled in a satisfactory manner. The employers in the China Clay industry were quite as anxious as anybody to see that their men were paid a living wage.

Police Chief's Retirement: Strike Memories

The China Clay district is particularly interested in the passing into retirement of Deputy-Chief Constable Banfield, for he is a St. Austell district boy, his parents having lived in the neighbourhood of Sticker, where Mr. Banfield was born. There have been times when Mr. Banfield has doubtless been disliked by wrongdoers for discharging his duty as a police officer, but there are very few cases in which he could be justly accused of harshness or vindictiveness. From the time when Mr. Banfield became a humble constable in the Cornwall Constabulary, until his retirement as the active police chief, it can be said that he has invariably interpreted his duties in the most generous spirit, and has shown how it is possible for an official to discharge them in an unofficious manner.

Perhaps the most trying period of his career, and one which called largely for his qualities of tact and sympathy, was during the China Clay strike of 1913, to which Mr. J. W. Higman referred at a recent sitting of the Petty Sessional Court, in conveying the Bench's felicitations on his retirement. Mr. Banfield knew the clayworkers, and the clayworkers knew him for a friend as well as a police officer. It was a source of much concern and regret to him when the necessity arose for the importation of the Glamorgan police during the strike to maintain law and order and to protect property. But he exercised remarkable patience in counselling forbearance on the part of the police before taking extreme measures, and it is a testimony to his wonderful handling of the situation that only once had the police to display force against the strikers. That was at Old Beam China Clay Works, near Bugle, when a crowd of men ignored the advice of their own leaders and defied the police, who were keeping the entrance to the pit, and became involved in a baton charge.

China Clay Merchant on 1927 Prospects

Cheaper fuel is expected to have a very beneficial effect upon the China Clay industry this year, and the prospects appear bright for the recovery of trade to the 1925 level. During the coal stoppage the use of foreign coal, the drying capacity of which was very much below that of British coal, increased the cost of drying China Clay from 3s. per ton before the stoppage to 9s. per ton at the end, when coal normally bought at 35s. to 40s. per ton cost 75s.

While reluctant to strike too optimistic a note as to the prospects of the industry in 1927, Mr. J. W. Higman, J.P., a director of China Clay Producers, Ltd., and senior partner in the old-established firm of J. W. Higman and Co., which has big connections with the American market, referred to the success with which the industry not only maintained but increased its American market in 1926. Over 300,000 tons had been shipped for the eleven months ended November, 1926. "This indicates," said Mr. Higman, "that the consumption of China Clay in America has increased enormously since 1914, for alongside increased consumption of English China Clays there has been an increased consumption of American domestic clays from about 100,000 tons per annum to approximately the consumption of English China Clay.

"Basing one's forecast for 1927 on the good volume of trade for 1926 despite industrial disturbances, I think it is safe to say the prospects for a prosperous new year for the China Clay industry are bright, seeing the advantage cheaper fuel will give it. As the year advances I believe the recovery in the home and European markets will continue."

Rotarians Discuss Industrial Arbitration

There was a large attendance of members at the weekly luncheon of St. Austell Rotarians recently, when attention was directed to a discussion of the paper given by Rotarian Dr. A. Shaw a fortnight before on how best to control and supervise industrial troubles in order to save the nation and innocent individuals from the disastrous recurrence of such disputes as that which has recently characterised the coal industry. Rotarian Shaw put his points in the form of an omnibus resolution: (1) That inquiries should be held as to the best methods of production, including a consideration of shops, machinery, and hours; (2) that in all basic industries a partnership of capital and labour be recognised, that labour have some say in the management and have some interest from the profits of the industry; (3) that no lock-outs or downing of tools be legal in any of these basic trades until such question or questions in dispute be referred to courts of arbitration or other tribunals, such courts to have power to say what is equitable and how the difficulty may be solved. Pending the inquiry, cessation of work should be deemed illegal.

An interesting discussion revealed the prevalence of a variety of points of view. Rotarian Hubbard advocated, amongst other things, the exclusion of Bolsheviks from this country, the taking of secret ballots among trade unionists in ascertaining their views on the subject in dispute, and the liability of trade union funds for illegal acts by members. He generally supported the proposal for the setting up of compulsory arbitration courts. Rotarian W. H. Graham gave an interesting account of the inception and development of the trade union movement, and doubted the practicability of carrying out the findings of an arbitration court if set up, where so many men were involved. He preferred to rely upon the common sense and patriotism of the community, for the cultivation of which they must look to their schools. Rotarian Keay advocated the regulation of the price of commodities sold, fixed at such a figure as would enable the employer to pay a reasonable wage.

Glue in Coated Papers

Paper has been coated on the coating equipment of the Bureau of Standards experimental paper mill, using glues of different grades as adhesives and using casein for comparison with the different types of minerals, China Clay, satin white and blanc fixe. The coated paper has been calendered and subjected to printing tests at the Government Printing Office. A demonstration of the use of glue in coated paper has been given to representatives of the glue manufacturers and of the coated paper industry, at which there were employed formulas which have been evolved to produce coated papers of satisfactory printing qualities. The results of laboratory studies of the individual factors involved in upwards of 100 experimental coatings on semi-commercial equipment, four demonstration trials on the same equipment, and the coating of five lots of paper on commercial equipment, point to the following general conclusions.

The proportion of glue required in coating mixtures varies almost inversely with the grade of the glue chosen and the amount of better grade glues required may be less than that of casein. The use of glue introduces no new difficulties in the preparation and application of coating mixtures containing wither, such as satin white. With proper selection of the glue used and adaptations to local conditions and product requirements the use of glue requires little change in equipment and involves little change in operating technique from procedure with casein. The various types of glue available permit considerable latitude in choice within which local conditions may be met. Variations in the other materials employed and in coating procedures influence largely the proportion of adhesive required to produce coated papers of satisfactory printing qualities. The use of ordinary glue-bound papers offers no new difficulties to the printer and engraver, at least as regards processes other than those of lithographic and possibly offset processes where a high degree of water resistance is required. Uniformity in glue for coating processes may be obtained by drawing specifications to meet local and product requirements. These results are given by G. K. Hamill, V. H. Bicking, and G. W. Bicking, in Technologic Papers of the U.S.A. Bureau of Standards, No. 321, 1926.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—December, 1926

Arrivals

Date.	Vessel.	From
December 5, S.S.	*Cromarty Firth*	Plymouth
December 7,	*Naiad*	Antwerp
December 7,	*Snowflake*	Newport
December 7,	*Defi*	Torquay
December 8, S.S.	*Spurn Point*	Barry
December 9,	*Diligent*	Plymouth
December 10,	*Irish Minstrel*	Newport
December 11,	*Isabel*	Truro
December 12,	*Pecheuse*	Douat
December 12,	*Catherine*	Torquay
December 13,	*St. Charles*	Bordeaux
December 14, S.S.	*Magrix*	Par
December 15, S.S.	*Goole*	Exmouth
December 17, S.S.	*Walnut*	Barry
December 17,	*St. Anne*	Par
December 17, S.S.	*Noah*	Par
December 18, S.S.	*Rosalie*	Teignmouth
December 19, M.V.	*Annie*	Kingsbridge
December 19, S.S.	*Cairnie*	Methil
December 22, M.V.	*Lydia Cardell*	Falmouth
December 22,	*Valonia*	Plymouth
December 30,	*Lady Jean*	Truro
December 31, S.S.	*Porthmeor*	Plymouth
December 31, S.S.	*Rosabelle*	Jersey

Sailings

Date.	Vessel.	Destination.
December 7, S.S.	*Cromarty Firth*	Aberdeen
December 8,	*Defi*	Nance
December 14,	*Isabel*	Salcombe
December 15, S.S.	*Magrix*	Gravesend
December 16,	*Pecheuse*	Nance
December 17, S.S.	*Goole*	Gravesend
December 18,	*Catherine*	Granton
December 18,	*Naiad*	London
December 20,	*Snowflake*	Runcorn
December 20, S.S.	*Rosalie*	Brussels
December 21,	*St. Charles*	Nance
December 21, S.S.	*Walnut*	Preston
December 22, S.S.	*Noah*	Grangemouth
December 22, S.S.	*Cairnie*	Leith
December 23,	*S. & F. Pearce*	Rochester
December 23,	*St. Anne*	Nance
December 24,	*Valonia*	London
December 28,	*Annie*	

Fowey Shipping—December, 1926

Arrived.	Name.	Sailed.	Destination.
Dec. 1, S.S.	*Brier Rose*	Dec. 4,	Runcorn
Dec. 1, S.S.	*Pansy*	Dec. 4,	Ridham
Dec. 2, S.S.	*Harptree Coombe*	Dec. 4,	Bristol
Dec. 2, S.S.	*Jellico Rose*	Dec. 4,	Dublin
Dec. 2, M.V.	*Donald and Doris*	Dec. 7,	Greenhithe
Dec. 2, S.S.	*Farfield*	Dec. 6,	Grimsby
Dec. 2, S.S.	*Abingdon*	Dec. 4,	Liverpool
Dec. 2, M.V.	*Bellmore*	Dec. 15,	Castellmare
Dec. 3, S.S.	*Pine*	Dec. 4,	Newlyn
Dec. 4, S.S.	*Jaarstroom*	Dec. 10,	Amsterdam
Dec. 4, S.S.	*Blush Rose*	Dec. 7,	Runcorn
Dec. 4, S.S.	*Lady Belle*	Dec. 10,	Weston Pt.
Dec. 4, S.S.	*Willowpark*	Dec. 11,	Boston, Mass.
Dec. 5, S.S.	*Emden*	Dec. 11,	Bremen
Dec. 5, S.S.	*Baron Ogilvy*	Dec. 14,	Philadelphia
Dec. 5, S.S.	*Mercurius*	Dec. 11,	Leith
Dec. 5, S.S.	*Gripfast*	Dec. 14,	Antwerp
Dec. 6, S.V.	*Defi*	Dec. 7,	Charlestown
Dec. 6, M.V.	*Shamrock*	Dec. 8,	Plymouth
Dec. 7, S.S.	*Baron Elibank*	Dec. 16,	Boston, Mass.
Dec. 7, S.S.	*Golfer*	Dec. 14,	Tayport
Dec. 7, S.S.	*Mars*	Dec. 16,	Skien
Dec. 7, M.V.	*Laanemaa*	Dec. 13,	Kotka
Dec. 8, M.V.	*Karnten*	Dec. 15,	Hamburg
Dec. 8, M.V.	*Caroline*	Dec. 15,	Bo'ness
Dec. 9, S.S.	*Wild Rose*	Dec. 16,	Preston
Dec. 9, S.S.	*Gower Coast*	Dec. 11,	Liverpool
Dec. 9, S.S.	*Ferndene*	Dec. 17,	Rouen
Dec. 10, S.S.	*Afon Towy*	Dec. 17,	Rouen
Dec. 11, S.V.	*Irish Minstrel*	Dec. 18,	Charlestown
Dec. 11, S.S.	*Ursula Siemers*	Dec. 21,	Philadelphia
Dec. 11, S.S.	*Foamville*	Dec. 15,	Landerneau
Dec. 12, M.V.	*Raymond Naval*	Dec. 21,	Raumo
Dec. 12, S.S.	*Northdale*	Dec. 17,	Rouen
Dec. 12, S.S.	*Sarnia*	Dec. 16,	Guernsey
Dec. 12, S.S.	*Mersey*	Dec. 17,	Ridham
Dec. 12, S.S.	*Primrose*	Dec. 18,	Runcorn
Dec. 15, S.S.	*Calluna*	Dec. 23,	Brussels
Dec. 15, S.S.	*Alice*	Dec. 24,	Runcorn
Dec. 15, S.S.	*Guelder Rose*	Dec. 18,	Runcorn
Dec. 15, M.V.	*Shamrock*	Dec. 18,	Plymouth
Dec. 15, S.S.	*Southwell*	Dec. 18,	Pasages
Dec. 15, M.V.	*Hela Naval*	Dec. 21,	Harburg
Dec. 15, S.S.	*Seaforth*	Dec. 15,	Swansea
Dec. 16, S.S.	*Zaanstroom*	Dec. 22,	Amsterdam
Dec. 16, S.S.	*Scartho*	Dec. 22,	Gothenburg
Dec. 16, S.S.	*Walnut*	Dec. 17,	Charlestown
Dec. 17, S.V.	*Transocean*	*	Genoa
Dec. 18, S.S.	*Teesbridge*	Dec. 25,	Portland, Me.
Dec. 18, S.S.	*Wyke Regis*	Dec. 24,	Antwerp
Dec. 18, S.S.	*Farfield*	Dec. 24,	Liverpool
Dec. 19, S.S.	*Gower Coast*	Dec. 24,	Liverpool
Dec. 19, S.V.	*Elise*	Dec. 19,	Charlestown
Dec. 19, S.S.	*Brier Rose*	Dec. 22,	Manchester
Dec. 20, M.V.	*Shamrock*	Dec. 21,	Plymouth
Dec. 20, S.S.	*Astoria*	Jan. 1,	Philadelphia
Dec. 21, S.V.	*Hilda*	*	Erith
Dec. 22, S.S.	*Joffre Rose*	Dec. 24,	Hull
Dec. 22, M.V.	*Gustaf*	Dec. 29,	Munkedal
Dec. 22, S.S.	*Elizabetta*	Dec. 24,	Preston
Dec. 22, S.V.	*Glory*	*	Christiansand
Dec. 23, S.V.	*Mary Barrow*	*	Rochester
Dec. 23, M.V.	*William Ashburner*	*	Rochester
Dec. 24, S.S.	*Pansy*	Dec. 24,	Swansea
Dec. 24, S.V.	*Noah*	*	Gravesend
Dec. 24, S.S.	*Marena*	Dec. 29,	Brest
Dec. 24, S.S.	*Cambalu*	Jan. 1,	Liverpool
Dec. 25, S.S.	*Jaarstroom*	Jan. 1,	Amsterdam
Dec. 26, S.S.	*Castle Town*	Jan. 2,	Portland, Me.
Dec. 26, S.S.	*Adour*	Dec. 31,	Bilbao & Pasages
Dec. 29, S.V.	*Marie*	*	Christiansand
Dec. 30, S.S.	*Evansville*	*	Philadelphia
Dec. 30, S.S.	*Briarpark*	*	Boston, Mass.
Dec. 30, S.S.	*Charlus*	Dec. 31,	Leith
Dec. 30, S.S.	*Gledburn*	*	Brussels
Dec. 31, S.V.	*R. Passmore*	Jan. 1,	Par
Dec. 31, S.S.	*Daisy*	*	Glasson Docks

* "In Port."

Par Harbour Shipping—December, 1926

Arrivals

Date.	Vessel.	From
December 1, S.S.	*Ville de Chalon*	Exmouth
December 2, M.V.	*Hope*	Plymouth
December 5, S.S.	*Treleigh*	Cardiff
December 7, S.V.	*Carmenta*	Antwerp
December 8, M.V.	*Kate*	St. Just
December 10, S.V.	*Isabell*	Plymouth
December 11, M.V.	*Hope*	Mevagissey
December 12, S.V.	*Noah*	Gothenburg
December 12, S.S.	*Spunpoint*	Charlestown
December 13, S.S.	*Magrix*	Teignmouth
December 14, S.V.	*St. Anne*	Port Talbot
December 15, S.V.	*Henrietta*	Rochester
December 16, M.V.	*Capable*	Exmouth
December 17, S.S.	*Hatchmere*	London
December 19, S.S.	*Knowl Grove*	Truro
December 21, S.S.	*Glenbrook*	Blyth
December 22, M.V.	*Kate*	St. Mawes
December 29, S.S.	*Treleigh*	Portreath
December 30, S.S.	*Magrix*	Hayle
December 31, S.V.	*R. Passmore*	Dartmouth

Sailings

Date.	Vessel.	Destination.
December 3, S.S.	*Ville de Chalon*	Rouen
December 6, M.V.	*Hope*	Plymouth
December 9, M.V.	*Kate*	Plymouth
December 10, S.S.	*Treleigh*	Garston
December 11, M.V.	*J. N. R.*	Plymouth
December 13, M.V.	*Hope*	Plymouth
December 14, S.V.	*Isabell*	Poole
December 14, S.S.	Magrix	Charlestown
December 16, S.S.	*Spurnpoint*	Charlestown

Date.	Vessel.	Destination.
December 16, M.V.	*Capable*	Rochester
December 17, S.V.	*Carmenta*	Antwerp
December 21, S.V.	*Noah*	Charlestown
December 21, S.S.	*Hatchmere*	Greenhithe
December 21, S.S.	*Knowl Grove*	Gravesend
December 22, S.V.	*Henrietta*	London
December 22, S.V.	*St. Anne*	Charlestown
December 25, S.S.	*Glenbrook*	Gravelines
December 31, S.S.	*Treleigh*	Preston

Par Harbour Tide Table, February, 1927

(*Greenwich Mean Time Throughout.*)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Tuesday	1	4.26	4.52	12.5
Wednesday	2	5.17	5.41	12.9
Thursday	3	6.5	6.28	13.5
Friday	4	6.50	7.12	13.9
Saturday	5	7.33	7.54	13.9
Sunday	6	8.16	8.37	13.5
Monday	7	8.58	9.19	12.10
Tuesday	8	9.40	10.2	12.0
Wednesday	9	10.27	10.56	11.1
Thursday	10	11.29	—	10.4
Friday	11	0.5	0.45	9.11
Saturday	12	1.27	2.9	10.2
Sunday	13	2.49	3.25	10.8
Monday	14	3.57	4.25	11.4
Tuesday	15	4.50	5.13	11.10
Wednesday	16	5.34	5.53	12.1
Thursday	17	6.10	6.27	12.4
Friday	18	6.43	6.58	12.7
Saturday	19	7.12	7.26	12.6
Sunday	20	7.40	7.54	12.5
Monday	21	8.9	8.23	12.1
Tuesday	22	8.37	8.52	11.7
Wednesday	23	9.8	9.25	11.1
Thursday	24	9.44	10.5	10.5
Friday	25	10.29	10.57	9.9
Saturday	26	11.30	—	9.4
Sunday	27	0.10	0.55	9.6
Monday	28	1.41	2.25	10.2

E. CLEMENS, Harbour Master.

China Clay Exports for December, 1926

A RETURN showing the exports of China clay, including Cornish or China Stone, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination registered during the month ended December 31, 1926:

COUNTRY OF DESTINATION.	QUANTITY. tons.	VALUE. £
Finland	1,241	1,284
Sweden	1,077	2,601
Norway	1,562	1,984
Denmark (including Faröe Islands)	395	1,032
Germany	4,383	9,259
Netherlands	2,579	6,142
Java	10	40
Belgium	3,558	5,926
France	2,990	6,498
Portugal	20	82
Spain	349	865
Italy	4,092	9,830
Greece	5	30
Bulgaria	1	11
China	—	2
United States of America	26,837	54,991
Mexico	40	167
Cape of Good Hope	—	3
Natal	—	2
British India	828	3,557
Madras	1	2
Bengal, etc.	225	636
Burmah	—	—
Ceylon	5	11
Australia	15	57
Canada	31	98
Total	50,244	105,110

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an*—followed by the date of the Summary, but such total may have been reduced.*]

FURNESS PAPER MILLS, LTD., London, W.C. Registered December 17, charge to Bank; charged on property at Ulverston.

HOWARD (WILLIAM) AND SON, LTD., Canterbury, paper manufacturers. Registered December 24, £1,500 2nd debentures part of £10,000; general charge. *£9,500. November 11, 1925.

HSIPAW PAPER AND PULP CO., LTD., London, E.C. Registered December 7, £5,000 debenture, to H. Heather, St. Margarets, Canadian Avenue, Catford; general charge. *Nil. December 31, 1925.

MARLEY TILE CO., LTD., Harrietsham. Registered November 29, £22,000 debentures (filed under sec. 93 (3) of the Companies (Consolidation) Act 1908), present issue £12,800; general charge.

NEW HALL POTTERY CO., LTD., Hanley. Registered January 1, £7,000 2nd debenture, to Barclays Nominees (Branches), Ltd., 4, George Yard, E.C.; general charge. *£18,000. January 28, 1926.

PACKS (1925), LTD. (late ERNEST WARDLE, LTD.), Feltham, paper manufacturers. Registered December 10, mortgage, to Bank; charged on property in Victoria Road, Feltham. *Nil. November 19, 1926.

REDHILL TILE CO., LTD. Registered November 27, £200 and further advances not exceeding therewith £800 charge, to T. Cotching, Horsham, solicitor; charged on properties in Honeycrock Lane, Salfords, Horley. *£4,500. July 17, 1925.

RODDY AND COOK, LTD., Cobridge, pottery manufacturers. Registered December 1, charge, to Bank; charged on property in North Street, Cobridge.

December Turnover

Second Best Month of 1926

DECEMBER finished up the year well by recording the second highest monthly deliveries, with a total of 91,200 tons in all classes—24,264 tons above November. China Clay was responsible for an increase of 24,715 tons, China Stone being down by 325 tons and Ball Clay by 126 tons. The highest monthly record, in June, was 92,909 tons, of which 88,820 tons were China Clay. The year's total at 934,775 has been brought within 23,910 tons of 1925—the best post-war year—and several thousand tons above 1924. The figures were:—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total. Tons.	
Port.	1926.	1925.	1926.	1925.	1926.	1925.	1926.	1925
Fowey	68,314	56,579	4,007	2,074	2,313	2,811	74,634	61,464
Charlestown	4,223	4,662	—	—	—	—	4,223	4,662
Par	2,927	3,107	—	239	—	—	2,927	3,346
Penzance	755	—	—	—	—	—	755	—
Falmouth	1,800	240	—	—	—	—	1,800	240
Plymouth	2,182	1,617	—	10	—	—	2,182	1,627
By rail	4,679	4,340	—	—	—	—	4,679	4,340
December	84,880	70,575	4,007	2,323	2,313	2,811	91,200	75,679
11 months	785,863	815,074	37,752	42,923	19,960	25,009	843,575	883,006
Whole year	870,743	885,619	41,759	45,246	22,273	27,820	934,775	958,685

China Clay Imports for December, 1926

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of December, 1926, indicates that the imports were nil.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

Trade in 1926

It is now possible to give a complete record of the trade done by the China Clay industry in 1926. Taking into consideration the many setbacks it experienced during the year, first with the general strike, then the protracted coal strike and the uncertainty as to whether or not the negotiations for the setting up of a new association would be successful, it is a matter for congratulation that the total business done in China Clay and China Stone should have reached the splendid total of 912,502 tons, China Clay being represented by 870,743 tons and China Stone by 41,759 tons. If we add the 22,273 tons of Ball Clay, which was a part of the business done by China Clay firms, the inclusive business done amounted to 934.775 tons, compared with 958,685 tons in 1925, a drop on the year of only 23,910 tons.

In considering these figures it must be borne in mind that 1925 figures were 64,345 tons in excess of 1924, so that during 1926 the statistics of total trade show that the industry maintained over 40,000 tons of the increase recorded in 1925 over 1924.

Overseas Trade well Maintained

On another page in this issue we give the details of the trade done in 1926, showing the quantities exported to overseas countries and the quantity absorbed by the home markets. An analysis of the figures given reveals a very healthy state in the overseas markets. The quantities exported to foreign countries reached the very fine total of 618,738 tons, to the value of £1,245,793. The quantity taken by British possessions overseas amounted to 37,124 tons, to the value of £112,716. The quantities absorbed by the home markets reached a total of 256,640 tons, to the value of £545,360. The total to all markets of China Clay and China Stone was 912,502 tons, to the value of £1,893,869, against 858,742 tons, to the value of £2,046,577, in 1924.

Increases and Decreases

It will be noted that of the 618,738 tons absorbed by the export trade, the United States was responsible for more than half, namely, 361,799 tons. Of the 37,124 tons sent to British possessions, India took 30,794 tons. The advances made by several of the foreign countries are worth noting; Finland, Esthonia, Latvia, Sweden, Germany, the Netherlands, Belgium, and the U.S.A. all show considerable increases over the 1924 figures, while Denmark and Spain remain practically stationary, France showing a decrease of over 6,000 tons and Italy a decrease of nearly 4,000 tons. The U.S.A. shows the biggest increase, being nearly 30,000 tons better, Germany showing, with a total import of 27,893 tons, an increase of 8,000 tons, the Netherlands with 40,221 tons an increase of nearly 6,000, and Belgium with 62,891 tons an increase of 5,000. The increases and decreases of other countries are comparatively slight, except in the cases of Norway with a decrease of over 4,000 tons and Sweden with a decrease of over 3,000 tons. A gratifying increase of trade is shown by the figures for Latvia, one of the new North Russia countries, which increased its tonnage from 519 in 1924 to 2,357 in 1926.

Ratio of Home Trade to Foreign

Further examination of the figures reveal the fact that in 1926 the ratio of business done in the home markets compared with the overseas markets was less than in 1924. This is accounted for by the fact that the home markets supplied with China Clay and China Stone from Devon and Cornwall were very much restricted on account of the coal strike. While it is hoped that the overseas markets will continue to expand, there is undoubtedly room for expansion in the home trade in 1927, having regard to the considerable leeway to be made up on account of the coal strike, which seriously affected the normal consuming capacity of such big consuming industries as paper-making, cotton, chemicals, and pottery.

First Month's Trade

The figures showing the business done in the first month of this year will also be found on another page. It will be seen that the total trade (China Clay, China Stone, and Ball Clay) amounted to 72,899 tons, being 759 tons below the corresponding month of 1925 and 18,301 tons below the December total. As predicted at the time, the big drop in the January total was not unexpected, it being known that buyers were taking in abnormally large supplies at the year end in order to avoid the higher prices that came into operation in the new year.

Rating of China Clay Area

At a meeting of the St. Austell Rural District Council recently, Mr. F. Dempster said he had noticed that the Press commented on the attitude they took at the last meeting towards the communication received from the clay firms with reference to the rates. He felt sure it was not their wish or the intention of the Council to treat the matter with contempt or to act discourteously towards those who sent it. Mr. T. Nicholls expressed the desire to refer to the same question and enlarge on what Mr. Dempster had said. He thought the clay merchants of the district had a very just reason to make the claims they had on the Council. The time the China Clay firms had been passing through was unparalleled in the history of the industry owing to the seven months of the coal strike, when the price of coal doubled. Consequently very serious inroads had been made into the financial position of many of the clay firms of that district. As a District Council they should heed and take warning from what the clay merchants had said, otherwise they might find that the rates they were expecting might not materialise. Seeing that the clay firms represented a large proportion of the rateable value, they had the right to ask the Council to consider seriously their programme of expenditure in the future and to recognise the necessity for economy.

The chairman said he did not think anyone wanted to ignore the letter sent by the clay companies, and he quite agreed that there were many in that room who were equally strong advocates of economy and tried as far as possible to keep the rates down. They asked the clerk to write acknowledging the letter, as they did when they received a letter from the Ministry.

China Clay Company's Action

Claim and Counter-claim

A CASE of interest to the China Clay industry was heard by Judge Gurdon at the last County Court at Truro, when actions arising out of the flotation and subsequent management of the Rosemellyn China Clay Co., Ltd., whose works are at Carbis in the neighbourhood of Bugle, occupied the Court for eight hours.

The first claim was by the Great Rosemellyn China Clay, Ltd., London, for £68 11s. 10d., balance due on goods delivered, against Charles Augustus Skynner and Reginald C. Augustus Skynner, trading as Skynner and Higson, St. Austell. Messrs. Skynner counter-claimed against the Rosemellyn China Clay, Ltd., for £72 2s. commission on sale of clay to Edward Lloyd, Ltd., London, at an agreed rate of 10 per cent. on £721, and rent of office. Aldryth R. Vivyan, Mount Charles, clerk, sued the Rosemellyn China Clay, Ltd., for £5 for one month's salary, in lieu of notice, and Ernest John Coslett, Mount Charles, sued the same company for £8, one month's salary, in lieu of notice. Mr. F. S. Laskey, barrister, instructed by Messrs. Dunn and Baker, Exeter, was for the China Clay Company, and Dr. H. Wright (Messrs. Stephens, Graham, and Wright), St. Austell, for Messrs. Skynner and Higson, Miss Vivyan, and Mr. E. J. Coslett. Mr. Laskey remarked that his client claimed £68 11s. 10d., and by the counter-claim the defendant had admitted the claim and the plaintiffs were entitled to judgment.

The Initial Arrangements

The cases were taken together, Dr. Wright remarking that the four arose from one set of facts. A partner of the firm of Skynner and Higson (Mr. C. R. Skynner) in 1924 heard of a clay sett at St. Blazey, approached the owner and acquired the lease. He afterwards saw Mr. H. W. Gould, solicitor, of Exeter, and it was agreed that Mr. Skynner and Mr. Gould should go into partnership, and after development, float it as a limited concern. Mr. Gould was to put up £1,000 in cash, arrangements were to be made for an overdraft, and for the developments of the company. Among other things it was arranged that Mr. Skynner, who lived at St. Austell (about seven miles from the works), should have the works office at his place in Charlestown, and that the financial and registered office should be, when the company was formed, at Exeter with Mr. Gould, who was to be the chairman of the company at a salary of £200 a year, and Mr. Skynner was to be director at £100 a year.

The Flotation of the Company

The company, after its formation on March 6, 1925, entered into an agreement to indemnify Mr. Gould and Mr. Skynner, the vendors, against all claims or obligations incurred in respect of the lease or the works. Prior to the formation of the company, the works were laid out by Mr. Reginald Skynner (son of Mr. Charles Skynner). The works were nearly at the producing stage when the company was floated. A clerk, (Mr. J. Rowse) was taken on by Mr. C. Skynner to do clerical work for the Great Rosemellyn partnership, and stayed on after the formation of the company at a salary of £2 per week. When he left, Miss A. R. Vivyan was engaged in his place at 25s. per week. Before the formation it had been agreed that Mr. Coslett, who was managing the office side of Messrs. Skynner and Higson, should be part-time clerk of the Great Rosemellyn Company when it reached the producing stage and should be paid £2 per week for his services. When Mr. Coslett's name appeared on the wages sheet, the secretary of the company wrote asking why it appeared. He was referred to Mr. Gould, and apparently Mr. Gould said it was in order, because no further complaint was made, and the name remained on the wages sheet.

There was only one issue in each of these two latter cases—was each of the particular plaintiffs employed by the Great Rosemellyn Company, and if so, what notice they were, respectively, entitled to receive on dismissal?

In the case in which Messrs. R. and C. Skynner were plaintiffs most of the items of the counter-claim were admitted by the plaintiffs, and the dispute centred round two items only—in one whether the company was liable for certain repairs to a Ford car, and in the other whether the company should pay anything for office accommodation at Charlestown. As the works were seven miles from the Charlestown office, Mr. C. Skynner said it was necessary to have some means of getting backwards and forwards. In conversation between Mr. Skynner and Mr. Gould with regard to a car, Mr. Skynner said he had an old Ford car that he was not going to do up for himself, but it might be done up and used temporarily for the purpose suggested. Mr. Gould advised that instead of going to a local dealer for parts they should be obtained from Parker's Garage at Exeter, in which he (Dr. Wright) believed Mr. Gould was interested. That was done, and a local mechanic, Mr. Johns, was employed to fit the parts to the car. The bill from Parker's Garage and Mr. Johns' employment to put the car in order was £27 17s. 4d. Application was made after the incorporation of the company for this, and also for the petrol used in connection with the car. No money was received for either, and about a year after the firm of Messrs. Stephens and Gould, Exeter, wrote a threatening letter on behalf of Parker's Garage in regard to the money. The claim of £15 5s. (also made on Messrs. Skynner and Higson) for petrol supplied had been admitted and the ten per cent. on the sales was agreed to by the directors.

Claims by Office Staff

Mr. Laskey contended that there was a specific agreement that there should be no rent paid for the office, and there was no agreement in regard to the Ford car or repairs.

Ernest J. Coslett gave evidence to the effect that he received £2 for the work he did as an employee of the company till it was terminated without due notice.

Miss Aldryth R. Vivyan said she was in the employ of the Great Rosemellyn Co., and was dismissed without due notice, but was taken on as clerk without a break, at the same salary, by Messrs. Skynner and Higson.

His Honour remarked that if she was in employ at the same wages for the month for which she claimed, she could not recover.

China Clay Merchant's Evidence

Charles Reginald Skynner, giving evidence, said Mr. Gould appointed his son, Reginald Skynner, as works manager at witness's suggestion and he was generally accepted as such. He (witness) was the only one of the directors with any knowledge of the clay trade, and he was appointed sole selling agent at 10 per cent. commission on sales, the minimum profit allowed to the middleman under the China Clay Association. He denied that he was not to receive commission till the clay he sold was paid for, and he had never heard of such a custom in the clay trade. He had worked as sales agent for other bigger firms, and was paid on account, at times, before the sale was actually made.

In reply to Mr. Laskey, witness said until the action was brought there was no suggestion of any payment of any office rent. The same would apply to his director's fees and expenses. Witness said there was no man in the country who could as middleman sell at 10 per cent. The expenses were enormous. He had to travel from Cornwall to Aberdeen and to other parts of the country on matters connected with clay business. If Mr. W. Rose said the custom was not to pay the agent till the sale was effected, he differed. When he obtained the order his work was done, and he had earned his money.

There being other witnesses to be called on both sides, the hearing was adjourned till the next Court.

Fowey Shipping in 1926

AT the last meeting of the Fowey Town Council, Alderman W. H. L. Shadman submitted the following report of the Fowey Port Sanitary Authority for 1926:—

The total number of ships using the port for the year was 961, a tonnage of 362,885. In 1925 the total was 1,031, with a tonnage of 391,727. Doubtless the industrial disturbances of the past year had been the cause of the decreased tonnage in the port. The Sanitary Inspector had visited 1,005 ships, including some at Looe, Par, and Charlestown. Fifty-four ships were dirty in crew's quarters and closets, but with three exceptions the defects were remedied before the ships left port. Ninety-one steamers were paid off.

Clay Drying Processes

Results Produced by Rotary Driers

BELOW we give information collected from various sources on the use of and results obtained from various forms of mechanical processes in the drying of China Clay. The source of the information is appended to each phase of the subject dealt with :

Improved clay drier that costs less and saves fuel : Invention of W. W. Swengel, Bloomsburg, Pa. Three superimposed rotating cylinders, all encased in brickwork chamber. It is claimed to cost less to install and saves 30 to 40 per cent. in fuel.—*American Clayworker.*

New method for drying clay.—Three pottery plants at Devon and Cornwall are now using a new method for drying clays in which two metal drums are employed, one enclosed in the other. The inner drum is driven by mechanical means and while revolving steam enters at a few degrees above the temperature of boiling water. The clay is passed into the outer drum and comes into contact with the inner drum as it revolves, filled with steam. The water in the clay is evaporated and the clay dried quickly, the process being one measured in minutes.—*Journal of American Ceramic Society.*

On the drying of raw clay.—Question : What is the most economical and efficient way to dry from 50 to 100 tons of fresh dug plastic clay in a day of nine to ten hours ?

Answer : A cylindrical drier is preferable on account of the large amount of labour it saves. Whether the drier should be vertical and stationary or inclined and rotary depends on the nature of the clay and on its properties during the drying. A plastic clay with 16 per cent. water has been dried for 20 cents per ton. The question of the desirability or otherwise of drying a plastic clay in order to work by a semi-dry process is a very different one ; in most cases it would be very unwise to endeavour to do so.—*British Clay Worker.*

Drying plants for clay and clay products.—R. Grunhut. In a rotary drier an ejector grate produces the necessary hot air and presses it through the drum, either on the counter-current principle, or, preferably, the continuous-current method, as in the latter case the wettest clay meets the hottest air and cannot lose its plasticity owing to overheating. Rotary drums show a high degree of efficiency, 6 lb. to 9 lb. of water can be evaporated with 1 lb. of coal, and one man can look after six and more drums. The wear is insignificant, and very little power is required to run the largest drums. Below are shown figures giving the efficiency of a counter-current drum. Average temperature of shell and furnace not over 150° F. Material was tested for specific heat. Coal tested calorifically.

Amount of coal burned per hour	400 lb.
Amount of moisture in coal	1 per cent.
Calorific value of coal	13,000 B.Th.U.
Material dried—clayey sand.	
Amount of wet material per hour	45,000 lb.
Amount of dry material per hour	42,750 lb.
Specific heat of material	0·21° F.
Moisture in material	5 per cent.
Temperature of air and materials	60° F.
Temperature of dried material	224° F.

Recapitulations of computations which are given :—

Loss by excess temperature of material	2·5 per cent.
Loss by heat in exhaust gases	6·5 per cent.
Loss by imperfect combustion	0·7 per cent.
Loss by radiation and other causes	4·5 per cent.
Drier efficiency	85·8 per cent.

English Ceramic Society Journal.

Centrifugal extractors v. *Filter presses.*—J. W. Mellor. In the hydro or centrifugal extractor the rapid rotation of a perforated cage containing the material drives the fluid portions through the walls of the cage and leaves the solid material behind. The process works well with fibrous materials and granulous substances, but not with finely divided substances. It was found that the clay slip forms a hard crust on the walls of the perforated cage. The crust is not permeable enough to permit the passage of water from the slip in the interior of the cage.

Later : There is a recent patent for drying China Clay in which the principle of the centrifugal extractor has been applied in a very ingenious way. The clay slip runs through the centre of a long cylinder with solid walls. The cylinder is rotated rapidly and solid clay collects on the walls of the cylinder, and water free from clay flows from the opposite end. When the exit water appears turbid the cylinder is emptied and again set to work.—*English Ceramic Society Journal.*

Need for Team Spirit

In China Clay Industry

AT the first ladies' evening organised in connection with the St. Austell Rotary Club, the proceedings took the form of a dinner followed by a musical programme at the White Hart Hotel, St. Austell, on February 9. The president (Rotarian Dr. W. Gilchrist) was in the chair.

Submitting the toast " Town and Trade of St. Austell," Rotarian Walter Graham, who is the secretary of the China Clay Owners Federation, Ltd., remarked that in the last 30 years they had undergone a phenomenal change for the better. Great as had been the progress made he did not believe they were yet at the high water mark of their prosperity, for which they depended to a large extent on other countries. There was a good deal left in St. Austell to do in improving and advancing what had been done in the last 30 years. He submitted some figures showing how the business of St. Austell had grown. At St. Austell Station in 1904 the incoming goods amounted to 28,843 tons and in 1926, 90,000 tons. The total outgoing traffic in 1904 was 34,000 tons and in 1926, 93,000. In 1904 the quantities of coal and coke coming in amounted to 6,000 tons and in 1926, 23,000. In 1890 ships taking away China Clay from Fowey had a net register of 163,000 tons and a carrying capacity of 400,000 tons, and in 1926 a net register of 428,000 tons and a carrying capacity of nearly a million tons.

Referring to the China Clay industry, he suggested that with all the wealth around them they should make a better thing of it than they did. The different firms engaged in the production of China Clay should be able to come together and work the industry as one organisation.

Responding, Rotarian E. J. Hancock, Managing Director of China Clay Companies, said he endorsed the remarks of Rotarian Graham in many respects.

As regards the China Clay industry he referred to the way in which Newton Abbot had grown into a big industrial centre as a result of the development of the ball clay fields in its midst, and the same might be done with St. Austell. " What was wrong with St. Austell ? What is wrong with Cornish people ? " asked Rotarian Hancock. There must be something radically wrong, he thought ; they had a great trade which might bear magnificent fruit for big numbers. He ventured to say that what was inherently wrong with most Cornishmen was that they lacked the team spirit. They would not pull together, but preferred to work individually, which arose largely from the fact that they were Celts, and had the Celtic characteristic of clannishness. Another difficulty was that they looked with suspicion upon others who came into the neighbourhood and were jealous of them instead of welcoming those who were in a position to help and were willing to co-operate in the development of the industry. Outsiders were looked upon as foreigners. It was not many years ago that outside financiers came to take an interest in the development of the China Clay industry, but they had not met with much encouragement.

Consolidated Mines of Cornwall

THE Consolidated Mines of Cornwall, Ltd. (combining Wheal Rashleigh, Luxulyan, Cornhill and Criggan China Clay pits) announce that for reasons of economy as well as in order to consolidate the business at its source, arrangements have been concluded to transfer the headquarters from London to Cornwall. For this purpose a new company has been formed (under the old board of directors) which will trade under the style of the New Consolidated Mines of Cornwall, Ltd., with registered offices at St. Austell. The address is St. Austell, Cornwall (T.N., St. Austell 320 ; T.A., Exchincla, St. Austell). The new company will take over all the business relations, agents and connections of the Consolidated Mines of Cornwall, Ltd., and it is the intention to maintain everything in future on the same lines so as to ensure the continuity of the business. All existing orders and contracts for China Clay will be taken over by the new company, and dealt with from the St. Austell office.

China Clay Notes and News

Familiar Harbour Master's Death

The death of Mr. John Charles Moore, which took place at a Truro nursing home, has removed one of the most respected and familiar personalities from the port of Charlestown. Deceased, who was 71 years of age, had been dock-master at Charlestown for nearly 40 years and had a life-long service with the proprietors of the Charlestown Estate Co. Throughout the whole of his official capacity he was regarded in the highest esteem. During his association with the docks, he had been instrumental in rescuing quite a number of lives, for which he received the recognition of the Royal Humane Society. His passing will be severely felt as an ardent though unobtrusive worker in the Wesleyan Methodist Church and Sunday School at Charlestown, and by his integrity and character and the great influence he exerted he has left behind an example of fidelity, wisdom, and zeal.

Stealing Clay Works Coal

At St. Austell Petty Sessions, Garnet Borlase, haulier, of Stenalees, pleaded guilty to stealing 215 lb. of coal from the engine house dump at Shilton Clay Works at Stenalees. P.C. Dyer said he was set to watch as the police had received complaints from the proprietor (Mr. Hutchinson) of coal being missed. He saw defendant deliver a wagon of coal to the dump and come away with some big lumps secreted in his otherwise empty wagon. When accosted, defendant excused himself by saying he had shares in the works, but afterwards admitted that was not so. Defendant expressed regret for the occurrence and said he had a great deal of bad luck.

The Chairman (Mr. J. W. Higman) in inflicting a fine of 10s. and costs, said that while they sympathised with defendant in his misfortunes, they did not justify him in stealing coal, of which there had been several complaints lately.

China Clay Agent's Fortune

Mr. William Mutton, of Alynbank, St. Austell, formerly of Charlestown, St. Austell, China Clay agent, left estate of the gross value of £12,668 with net personalty £7,689. Probate of the will has been granted to his sons, Frederick Wills Mutton, of Morlaix, St. Austell, merchant, and George Ernest Mutton, of Alynbank, ship broker. The testator left £1,500 to his son William, £1,500 to his son John, £1,500 to his daughter Hannah Warren, £50 to St. Austell Cottage Hospital, £20 to St. Austell Nursing Association, £10 each to the United Methodist Sunday school, Carclaze, and the Charlestown Wesleyan Sunday school; his premises known as Carmeronia and Ambleside, Watering Hill, St. Austell, to his daughter Ethel May Mutton; lands and premises at Screeda, St. Austell Rural, to his son William; premises known as Marston, Auburn, Walden, and Clayton, Watering Hill, St. Austell, in trust for his grand-daughter, Marjorie Beatrice Bowen; and the residue of the property upon trust for his wife, and subject thereto the ultimate residue of the property upon trust for his children, Frederick Wills Mutton, George Ernest Mutton, and Ethel May Mutton, in equal shares. The testator's wife pre-deceased him by a few days.

China Clay Prices in U.S.A.

The following letter has been received by a St. Austell China Clay producer from an American China Clay importing firm with reference to China Clay prices which were said to be quoted for 1927, to which we referred in our last issue.

"Referring to the clipping in which is quoted a paragraph from the *Paper Trade Journal* we wish to remark that it is one thing to make a quotation, still another to advise people what to do. If the producers were to follow the advice of your local paper and 'not to be eager to enter into contracts,' we are afraid they would not sell much clay, more especially if they were waiting for a proportion of the increase as stated in the *Paper Trade Journal*. We do not know where this trade paper received the information about the advance of about $2.00 per ton. Certainly not from us. On filling clays we have received just a few pence over the highest price paid last year. Coating clays are selling at a price of about two shillings a ton less than we received last year.

"With all our other clays in no case are we receiving higher prices than we received last year, and in some cases the prices are less than we received last year for the same clays. It is a pity that some of these trade papers are so ready to print any article that might be submitted without first looking up the authenticity for the same."

120-Year-Old Record of Fowey

In an old volume published in London in 1806, that has been recently unearthed, there appears an interesting account of Fowey, the following excerpts from which will be interesting to readers of the CHINA CLAY TRADE REVIEW: "The old and well-known apophthegm *omnium rerum vicissitudo* was never more strongly exemplified than in the site of Fowey, or as anciently spelt and commonly pronounced, Foy. From a place of the first consequence in the times of yore, sweeping the sea with her ships, and even overaweing France herself, this place may be said to have been buried in the shade of obscurity. Nature, however, has not deserted her. The hills, the harbour, the ocean preserve their grand and venerable features; while the castle at the entrance of the port has unfortunately yielded to the irresistible arm of Time. The little town of Fowey is pleasantly situated. It possesses a spacious and beautiful harbour, decently fortified, calculated by its safety and depth of water, as well as facility for entrance, for commerce on the most extended scale. The town is nearly one mile in length, its streets narrow, but, nevertheless, containing many well-built houses. The noble range of ocean before the town, the surrounding hills, the rocky scenery, the old castle, with other venerable ruins, afford ample scope for the genius of the painter and poet. The sea forces itself five or six miles through the country, as far as the town of Lostwithiel, remarkable for some remains of a palace, and the noble castle of Restormel in its vicinity. Several pleasant creeks are also formed by the sea, on whose sides many villas command attention and inspire pleasure. Nevertheless, with all these beauties and with all its advantages, Fowey has been, until of late, a neglected spot."

Cornwall Rates and China Clay Trade

In view of the fact that the Cornwall County Council Finance Committee has agreed to receive a deputation from the China Clay firms on the subject of the rates, the following details of estimated expenditure for 1927-28 are interesting.

The County budget presented to the County Finance Committee stated that the estimated expenditure for 1927-28 showed a decrease of £12,337 as compared with the actual expenditure for the current financial year. This decrease was mainly due to the reductions in estimated expenditure on highways and registration of electors. The decrease in estimated expenditure was offset to the extent of £12,337 by reductions in corresponding receipts. These reductions in the estimated receipts were in respect of highways and in the amount to be received from the Exchequer contribution account. It was considered that a rate of 2s. 10d. in the £ would be required on the general county account for the next financial year, being an increase of 3d. on the rate of 2s. 7d. for 1926–27. In considering the increase in this rate it should be noted that the estimated net expenditure for 1926–27 represented a rate of 2s. 11½d. in the £, but it was possible to meet this expenditure by means of a rate of 2s. 7d., the remaining amount being taken from the working balance.

On the special county account the estimated expenditure showed an increase of £3,005 over the actual expenditure for the current financial year. This was chiefly due to the amounts provided for expenditure under the headings of police pensions, county bridges, Diseases of Animals Acts, and Tuberculosis Order, 1925. On the other hand, the total receipts also showed an increase amounting to £921. A similar rate to that levied in the current year, 9¾d. in the £, would be required. For elementary education the estimated net expenditure was approximately the same as for this year, but it was possible to reduce the rate for the ensuing year by 1d.—2s. 2d. to 2s. 1d.—by using part of the working balance. In the absence of a reduction in net expenditure it might be necessary in 1928–29 to reimpose the 1d. rate to be foregone in the coming year.

During the greater part of the present year there had been an overdraft on the higher education account, and it was necessary to increase the rate by 1d.—from 6½d. to 7½d. The development of the rural library necessitated an increase of ¼d. in the pound, from ¼d. to ½d.

The total rates required were 6s. 4¾d. as compared with 6s. 1½d., an increase of 3¼d.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—January, 1927

Arrivals

Date.	Vessel.	From
January 5	s.s. *Charbomine*	Totnes
January 6	s.s. *Rosalie*	Torquay
January 6	s.s. *Pattersonian*	Dartmouth
January 9	s.s. *Pegrise*	Totnes
January 10	*Esperance*	Plymouth
January 16	*Wellington*	Mevagissey
January 16	s.s. *Magrix*	Truro
January 18	s.s. *Admiral*	Plymouth
January 19	s.s. *Freighter*	Salcombe
January 19	s.s. *Charbomine*	Paignton
January 20	s.s. *Stanwell*	Torquay
January 20	s.s. *Trader*	Jersey
January 21	s.s. *Coaster*	Plymouth

Sailings

Date.	Vessel.	Destination.
January 1	s.s. *Porthmeor*	Runcorn
January 3	*Lady Jean*	Snodland
January 3	*Lydia Cardell*	Sunderland
January 4	s.s. *Rosabelle*	Liverpool
January 5	*Irish Minstrel*	Runcorn
January 5	*Erhardt*	Aberdeen
January 6	s.s. *Charbomine*	Brussels
January 7	s.s. *Pattersonian*	Erith
January 7	s.s. *Rosalie*	Brussels
January 11	s.s. *Pegrix*	Tayport
January 12	*Esperance*	Boulogne
January 17	s.s. *Magrix*	Gravesend
January 18	*Wellington*	Goole
January 19	s.s. *Freighter*	Gravesend
January 21	s.s. *Stanwell*	Rochester
January 21	s.s. *Admiral*	Fleetwood
January 21	s.s. *Charbomine*	Brussels
January 21	s.s. *Trader*	London
January 24	s.s. *Coaster*	Antwerp

Fowey Shipping—January, 1927

Arrived.	Name.	Sailed.	Destination.
January 1, s.s.	*Ferndene*	January 6,	Antwerp
January 1, s.s.	*Marta*	January 6,	Harburg
January 1, s.s.	*Mersey*	January 6,	Ridham
January 1, s.s.	*Leaside*	January 8,	Antwerp
January 1, s.s.	*Inga*	January 7,	Odense
January 2, s.s.	*Hanna*	January 7,	Karlscrona
January 2, s.s.	*Oder*	January 12,	Antwerp
January 3, s.s.	*Eskburn*	January 10,	Antwerp
January 3, s.v.	*Makur*	January 15,	Leith
January 3, s.v.	*Elise*	January 15,	Kirkcaldy
January 4, s.s.	*Brier Rose*	January 11,	Larne
January 6, s.s.	*Ardgantock*	January 8,	Antwerp
January 6, s.v.	*Punctum*	January 15,	Leith
January 6, m.v.	*Dietrich Hasseldieck*	January 8,	Terneuzen
January 6, s.v.	*Irish Minstrel*	January 19,	Runcorn
January 7, s.s.	*Stanwell*	January 12,	Nieuport
January 7, s.s.	*Birmingham*	January 11,	Manchester
January 7, s.v.	*Jane Banks*	January 15,	Runcorn
January 8, s.s.	*Pacific Pine*	January 13,	Los Angeles
January 8, s.s.	*Devon Coast*	January 13,	Liverpool
January 8, s.s.	*William Campion*	January 15,	Norfolk, U.S.A.
January 9, s.s.	*Marena*	January 12,	Brest
January 9, s.s.	*Hayle*	January 12,	Preston
January 9, s.s.	*La Tamise*	January 10,	Terneuzen
January 10, s.s.	*Albert Jeffries*	January 19,	Philadelphia
January 11, s.v.	*Rossing*	January 19,	Drammen
January 12, s.s.	*Farfield*	January 15,	Grimsby
January 12, s.s.	*Rossmore*	January 15,	Bo'ness
January 13, s.s.	*Ardri*	January 15,	Preston
January 13, s.s.	*Vechtstroom*	January 18,	Amsterdam
January 13, m.v.	*Hope*	January 17,	Truro
January 13, s.s.	*Porthmeor*	January 18,	Weston Point
January 13, s.s.	*Hampshire Coast*	January 19,	Liverpool
January 14, s.s.	*Plodder*	January 19,	Rouen
January 15, s.s.	*Pylades*	January 19,	Methil
January 15, s.s.	*Blush Rose*	January 19,	Preston
January 15, s.s.	*Tashmoo*	January 23,	Philadelphia
January 15, s.s.	*Shoreham*	January 20,	Runcorn
January 15, s.s.	*Primrose*	January 19,	Preston
January 18, s.s.	*Pansy*	January 22,	Runcorn
January 18, s.s.	*Alster*	January 22,	Norrkoping
January 18, s.s.	*Westerham*	January 24,	Antwerp
January 19, m.v.	*Palawan*	January 31,	Genoa
January 20, s.s.	*Mersey*	January 25,	Weston Point
January 20, s.s.	*Goodig*	January 29,	Preston
January 20, s.s.	*Brier Rose*	January 25,	Runcorn
January 20, s.s.	*La Tamise*	January 27,	Harburg
January 22, s.s.	*Ferndene*	January 27,	Antwerp
January 22, s.s.	*Clara Monks*	January 27,	St. Valery
January 22, s.s.	*Glenshesk*	January 29,	Runcorn
January 23, s.s.	*Calluna*	February 1,	Brussels
January 23, s.s.	*Inger*	January 26,	Helsingfors
January 26, s.s.	*Gower Coast*	January 31,	Birkenhead
January 29, s.s.	*Amstilstroom*	February 1,	Amsterdam
January 29, s.s.	*Fort Armstrong*	*	Philadelphia
January 31, s.s.	*Kyanite*	February 2,	Penryn
January 31, s.s.	*Eskbridge*	*	Portland, Me.
January 31, s.s.	*Wheatlands*	February 1,	Garston
January 31, s.s.	*Hayle*	February 2,	Runcorn

*In port.

Par Harbour Shipping—January, 1927

Arrivals

Date.	Vessel.	From
January 1, s.s.	*Condor*	Falmouth
January 4, s.s.	*Abbington*	Falmouth
January 5, s.s.	*T. W. Stuart*	Kingsbridge
January 6, s.s.	*La Tamise*	Poole
January 8, s.s.	*Pegrix*	Totnes
January 11, s.s.	*Multistone*	Blyth
January 11, s.v.	*Rose*	Falmouth
January 16, s.v.	*Fanny Crossfield*	Falmouth
January 18, s.s.	*Southwell*	Guernsey
January 19, s.v.	*Winifred*	Plymouth
January 19, m.v.	*Kate*	Falmouth
January 19, s.s.	*Knowl Grove*	Truro
January 20, s.v.	*Ivy*	Porthoustock
January 21, s.s.	*Foy*	Porthleven

Sailings

Date	Vessel.	Destination.
January 1, s.s.	*Magrix*	Gravesend
January 5, s.s.	*Condor*	Antwerp
January 5, s.s.	*T. W. Stuart*	Rochester
January 5, m.v.	*Kate*	Plymouth
January 8, s.v.	*R. Passmore*	Erith
January 8, s.s.	*Abbington*	Weston Point
January 8, s.s.	*La Tamise*	Fowey
January 9, s.s.	*Pegrix*	Charlestown
January 15, s.s.	*Multistone*	London
January 19, m.v.	*Kate*	Plymouth
January 20, s.v.	*Rose*	London
January 21, s.s.	*Knowl Grove*	London
January 22, s.v.	*Fanny Crossfield*	Newcastle
January 22, s.s.	*Southwell*	Terneuzen
January 23, s.v.	*Winifred*	Plymouth

Par Harbour Tide Table, March, 1927

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Tuesday	1	3.5	3.40	11.4
Wednesday	2	4.9	4.35	12.6
Thursday	3	5.0	5.24	13.5
Friday	4	5.47	6.10	13.9
Saturday	5	6.33	6.55	14.4
Sunday	6	7.16	7.36	14.5
Monday	7	7.55	8.15	14.0
Tuesday	8	8.35	8.54	13.3
Wednesday	9	9.13	9.35	12.2
Thursday	10	9.58	10.24	11.0
Friday	11	10.54	11.29	10.0
Saturday	12	—	0.12	9.5
Sunday	13	0.59	1.47	9.7
Monday	14	2.31	3.9	10.3
Tuesday	15	3.41	4.8	11.1
Wednesday	16	4.31	4.52	11.9
Thursday	17	5.11	5.29	12.3
Friday	18	5.46	6.2	12.5
Saturday	19	6.17	6.31	12.8

Day of Week.	Day of month.	Morning.	Afternoon.	Height.
Sunday	20	6.45	6.59	12.10
Monday	21	7.13	7.27	12.8
Tuesday	22	7.40	7.53	12.5
Wednesday	23	8.7	8.21	11.11
Thursday	24	8.36	8.53	11.4
Friday	25	9.12	9.33	10.8
Saturday	26	9.57	10.25	9.11
Sunday	27	10.58	11.38	9.4
Monday	28	—	0.25	9.5
Tuesday	29	1.12	1.57	10.3
Wednesday	30	2.38	3.14	11.5
Thursday	31	3.45	4.12	12.8

E. CLEMENS, Harbour Master.

China Clay Exports for January, 1927

RETURN showing exports of China Clay, including Cornish or China Stone, the produce of the United Kingdom from the United Kingdom to each country of destination as registered during the month ended January 31, 1927:

COUNTRY OF DESTINATION.	QUANTITY. Tons.	VALUE. £
Sweden	1,106	3,466
Norway	1,202	1,433
Denmark	687	1,865
Germany	1,342	2,619
Netherlands	7,328	15,096
Belgium	5,645	10,548
France	348	510
Spain	1,451	3,974
Italy	977	1,612
Greece	13	79
Bulgaria	1	11
Roumania	5	22
China	11	64
United States of America	38,083	78,892
Peru	5	24
Brazil	20	100
Argentine	400	1,515
Bombay, *via* other ports	3,157	13,723
Madras	129	585
Bengal	255	765
Australia	103	438
Irish Free State	2	5
Total	62,270	137,346

January Deliveries

Fall from December Figures

As was expected, the turnover in January fell considerably below the bumper total recorded in December, when buyers made unusually large purchases to get the full benefit of the lower prices that ruled to the end of the year. The following are the details :—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total. Tons.	
Port.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.
Fowey	46,976	51,798	4,147	3,711	2,569	3,156	53,692	58,665
Charlestown	5,016	4,135	—	—	—	—	5,016	4,135
Par	3,800	3,285	148	31	—	—	3,948	3,316
Plymouth	1,699	1,948	80	—	—	—	1,779	1,948
Looe	—	194	—	—	—	—	—	194
Penzance	1,710	851	—	—	—	—	1,710	851
Falmouth	1,377	240	—	—	—	—	1,377	240
Newham	186	—	—	—	—	—	186	—
By Rail	5,191	4,309	—	—	—	—	5,191	4,309
January	65,955	66,760	4,375	3,742	2,569	3,156	72,899	73,658
December	—	84,880	—	4,007	—	2,313	—	91,200

China Clay Imports

THERE were no registered imports of China Clay or China Stone into Great Britain and Northern Ireland during the month ending January 31.

Drilling for Potash

A CONTRACT for drilling a test well in Eddy County, in south-eastern New Mexico, for potash exploration purposes, has been awarded to the Sullivan Machinery Co., Chicago, by the Director of the U.S.A. Bureau of Mines, with the approval of the Secretary of Commerce. Drilling operations will begin at once. This marks the beginning of the actual drilling campaign under the supervision of the Federal Government in an effort to obtain ample domestic potash supplies.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an*—followed by the date of the Summary, but such total may have been reduced.*]

BONES GATE BRICK AND TILE CO., LTD., Ewell. Registered January 12, £2,000 debentures; general charge.

KELLNER-PARTINGTON PAPER PULP CO., LTD., Manchester. Registered January 6, Trust Deed, dated December 17, 1926, securing £1,230,000 debenture stock, redeemable at 101 per cent.; charged on properties in Norway and Austria and also general charge, subject to existing debenture stock. *£1,500,000. December 31, 1925.

SMITH AND BARNETT, LTD., Longton, pottery manufacturers. Registered January 25, £500 debentures; general charge.

Satisfactions

NATIONAL PAPER AND PULP CO. (1920), LTD., London, E.C. Satisfaction registered January 27, £600, part of amount registered January 26, 1921.

NEW HALL POTTERY CO., LTD., Hanley. Satisfaction registered December 31, £5,000, registered August 21, 1912.

PORTALS, LTD., Whitchurch (Hants), paper manufacturers. Satisfaction registered January 28, £88,000, part of amounts registered April 8, 1921, to May 23, 1922.

China Clay Trade in 1926

Second Best Year Since the War

BELOW we give the statistics relating to the China Clay trade in 1926, which includes China Clay and China Stone, but not Ball Clay. Comparisons are also given with the years 1924 and 1923. The total trade for 1925, including home and export trade, amounted to 936,537 tons. The proportion of China Clay tonnage and that of China Stone for the year, the China Clay figures being given first in each case, were :—1926 : 870,743—41,759. Total, 912,502. 1925 : 930,573—45,964. Total, 976,537. 1924 : 808,615—50,127. Total, 858,742. 1923 : 747,676—40,188. Total, 787,864.

Country.	1926. Quantity. Tons.	1926. Value. £	1924. Quantity. Tons.	1924. Value. £	1923. Quantity. Tons.	1923. Value. £
Finland	19,547	12,903	9,976	21,239	10,763	21,276
Esthonia	2,378	3,388	1,891	3,448	1,116	2,226
Latvia	2,357	4,200	519	1,891	406	1,051
Sweden	20,634	41,977	17,475	37,640	19,033	43,661
Norway	14,202	19,722	20,702	37,791	13,462	22,623
Denmark	3,820	9,625	3,616	10,135	2,923	8,032
Germany	27,893	60,894	19,742	48,822	6,735	24,285
Netherlands	40,421	86,697	34,534	84,154	22,121	55,146
Belgium	62,891	107,526	57,696	112,173	60,519	122,385
France	28,949	53,270	35,035	74,276	36,046	78,786
Spain	15,636	36,085	15,183	42,168	11,605	36,028
Italy	23,517	61,104	27,448	74,424	20,193	54,384
Japan	107	680	4	26	168	1,208
Dutch E. Indies	105	395	322	1,293	—	—
U.S.A.	361,799	734,984	331,900	761,728	286,405	680,515
Mexico	1,194	4,856	883	3,731	595	2,496
Argentine	360	2,520	1,571	5,373	385	1,721
Rest S. America	420	1,639	110	541	134	607
Other Foreign Countries	1,494	3,273	35,764	77,015	1,521	4,825
TOTAL	618,738	1,245,793	579,838	1,323,894	494,110	1,161,075
BRITISH :						
India	30,794	86,938	20,508	79,827	16,196	63,528
Canada	1,564	4,700	5,756	14,152	7,319	18,017
Newfoundland	3,322	4,397	2,802	5,157	2,489	4,600
Africa	957	3,913	3,488	13,255	20	50
Australia	486	2,767	448	2,438	397	2,339
Other British Possessions	1	1	550	454	215	777
TOTAL BRITISH	37,124	102,716	33,552	116,283	26,636	90,371
Total Overseas Trade	665,862	1,348,509	603,390	1,440,167	520,746	1,251,446
Total Home Trade	256,640	545,360	255,352	606,410	267,118	678,939
Total Home and Overseas	912,502	1,893,869	858,742	2,046,577	787,864	1,930,385

The China Clay Trade Review

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China Clay Research

WHILE the old China Clay association was in being, there was set up in connection with it, a committee whose special function was to undertake research work with a view to exploring the possibilities of extending its use in more or less specialised commodities for which China Clay sold in bulk without any special preparation was not considered suitable. With the break-up of the association, whose functions were more than merely grading and fixing the prices of China Clay, the prospects of a really effective central research organisation was dissipated.

A few years ago a suggestion was made in the columns of this review for the establishment of a central laboratory in which the suitability of China Clay for other purposes than those for which it is generally used might be ascertained. Under an association embracing the whole industry such a laboratory might have been of incalculable benefit to the industry as a whole and have opened up new markets for China Clay. Though the changed circumstances following the break-up of such an association has rendered a central laboratory impracticable, it must not be concluded that no research work is being undertaken, for we understand that in two or three of the larger China Clay companies and some of the small ones, laboratories have been set up or a qualified chemist engaged for the purpose of the investigation of possibilities for new uses for China Clay.

Colloidal Clay Possibilities

Perhaps the direction in which most of the research work has been done has been in ascertaining the possibilities of the development of processes for the production of colloidal clay, attention to which was first attracted by the late Mr. Frank E. Weston, B.Sc., F.I.C., in THE CHEMICAL AGE. There is no doubt that colloidal clay is being produced and sold at a high price, but it is questionable whether its possibilities have been explored to the extent it might, and that the uses to which it might be put have been anything like exhausted. Mr. Weston, as a result of a special study of colloidal clay, which he undertook in his laboratory at the Polytechnic, was convinced that its properties rendered it valuable in many industries, and that he was understating the case when he said that colloidal clay would revolutionise many industries.

Soap

We gather from his observations that one of the first uses to which colloidal clay has been put is soap manufacture. Hitherto China Clay, as such, has been used as a filling agent, but colloidal clay when incorporated into soap by a special process actually improves the detergent and lathering qualities of the soap. Soaps containing from 20 to 30 per cent. of colloidal clay are better detergents than the original soaps with which the clay is incorporated. Soap is a colloidal substance, and owing to the colloidal nature of the prepared clay perfectly homogeneous mixtures of colloidal clay and soap are easily obtained, from which the clay does not separate when dissolved in water.

Other Uses

The uses of colloidal clay in the oil industry are many and varied, and its employment as a catalyst in the production of hardened fat, for example, margarine, has just been disclosed to the world.

Many other uses have already been found for colloidal clay which are of world wide importance, but what has not been stated so far is that by the use of colloidal clay the cost of manufacture in many industries will be greatly reduced.

Hitherto the use of China Clay, as such, has been that of an adulterant or filler, whilst to-day colloidal clay is being used for entirely new purposes as an active principle, and that the world will be the richer by the discovery of this colloidal clay is open to no shadow of doubt.

The Production of Colloidal Clay

The colloidal clay sold by some China Clay firms is a term applied to a very highly refined China Clay, the fineness of which is secured by passing it through a grinding mill, but the true colloidal clay is produced by processes of refining which results in a material of very fine texture, from which all suspicion of grit is entirely eliminated. This special prepared colloidal clay is already being used in a number of articles of consumption, including some of the special preparations well known to pharmacy. Its use is particularly desirable in materials used in industries where absolute purity is essential and where smoothness of texture and freedom from grit of any kind is most important. Especially is this so in the case of mixtures used in rubber. Some time ago we were informed by an industrial chemist that French chalk was used in rubber manufacture by certain big industrial concerns whose commodities have a world wide reputation, who were prepared to consider its substitution by China Clay provided that it was absolutely free from grit. This would seem to be a market that might be cultivated by producers of real colloidal clay, as distinct from the best China Clay produced in the ordinary process of washing in vogue in the China Clay industry.

Other uses to which colloidal clay is being put is in the preparation of toilet requisites, especially in toilet powder, tooth paste, and similar manufactures.

Trade Secrets

It is well known that there are a number of uses to which China Clay is now put that are kept a profound secret. The manufacturers of these commodities have ascertained the value of China Clay for these purposes as a result of investigations undertaken in the laboratory, and there is no reason why the technical staffs of China Clay firms should not be able to undertake similar investigations.

The question is often raised by people more concerned with the scientific and chemistry side of industry, as to whether China Clay producers have realised sufficiently the scope for their product in new markets, which might be fostered if they were in a position to give "chapter and verse" for the claims they make for its suitability in more or less specialised commodities.

China Clay and its Testing

A Paper before the Papermakers' Association

At the first meeting of the South of Scotland Division of the Technical Section of the Papermakers' Association of Great Britain and Ireland, held recently, Mr. J. Strachan, F.Inst.P., F.R.M.S., read a paper entitled, "Some Notes on China Clay and China Clay Testing." A description was given of the mode of occurrence of China Clay and some account of the theory of its origin. This was illustrated by means of a series of specimens showing the gradual transition of granite to China Clay rock by kaolinisation of the felspar. A description was also given of the methods used in Cornwall for winning the clay by washing, cleaning, settling, and drying. Mr. Strachan pointed out that China Clay as sold to the papermaker consisted of kaolin mixed with from 5 per cent. to 15 per cent. of mica and fine sand. Even in the case of the finer grades of China Clay anything over 95 per cent. of kaolin was exceptional. China Clay was graded in quality according to its degree of whiteness. The lowest grades or "mica" clays contained up to 50 per cent. of mica and sand, and were grey in colour. The higher grades contained less, and were frequently varied in colour by the presence of other impurities.

Causes of Colour

Organic matter in the form of peaty colloids, such as Humic Acid, gave a yellow colour to the clay. A yellow colour was also imparted by the presence of hydrated oxide of iron, and frequently both organic matter and iron were together present in the yellow or creamy coloured clay. Another oxide of iron was also responsible for a pink tinge in the clay, while a yellow clay might also be tinged with red from this source. Certain high grade clays had a natural bluish-white colour. The blue colour was derived from the presence of tourmaline, which, from the papermaker's point of view, was very objectionable, being a very hard and dangerous kind of grit. Occasionally China Clay had a distinct greenish shade, due to the presence of unicellular algæ. This was objectionable. Very occasionally clay was blued artificially by the producers; but this was quickly detected by the papermaker, who preferred to do his own tinting. Much more objectionable than the blue were other impurities added unintentionally by the producer, such as brush bristles and wood fragments from the "micas," vegetable growths of blue-green algæ from the washing water, leaves and other vegetable detritus blown into the settling tanks during rough weather, and coal fragments from the railway wagons at the "drys."

Generally speaking, the methods used in winning and washing the clay in Cornwall were rather primitive; but improvements in methods of cleaning and drying were being effected, and signs were evident that the China Clay producers were waking up to the usefulness of some applied science in the industry. Even the better grades of China Clay at the present day could not be regarded as pure kaolin; but it must be admitted that under the circumstances, China Clay was a wonderfully cheap product, considering the laborious processes involved in producing it. Enormous quantities of China Clay had been won in Cornwall during the past century, and much had been wasted in the process. In spite of this the speaker believed that Cornwall would still hold its place for the next two centuries as the world's chief source of the best kaolin available for papermaking and other purposes.

Methods of Testing

In testing China Clay used for papermaking, four points were of great importance, viz.: moisture content, colour, gritty impurities, and colloidal properties.

Moisture.—The natural moisture content of air-dry clay was under 1 per cent., but 10 to 12 per cent. of moisture was a reasonable figure. If the drying of the wet slip was pushed beyond this with the present method of drying on the kiln, there was invariably some burning of the clay and destruction of the colloidal qualities. In addition to this, clay with less than 10 per cent. of moisture became powdery, involving serious losses in handling and during transit. Distinct from the moisture content which was rapidly removed at 105° C., kaolin contained theoretically about 14 per cent. of combined water, which was completely driven off at red heat. Practically it was found that commercial qualities of kaolin or China Clay rarely yielded more than 12 per cent. of combined water. Very high grade clays gave about 13 per cent.

Colour.—The colour of China Clay was generally judged by mixing the samples with water into a creamy consistency on a glazed porcelain plate or tile. This was the principal test used by the producer in grading clays, and the method of carrying out this examination did not vary very much.

Gritty Impurities.—There was no standard method of estimating gritty impurities established in the paper trade. The American method of sieving was not satisfactory, as much fine "mica" and sand passed through the finest sieve used in this test. Elutriation tests varied considerably with the type of apparatus employed, and were both laborious and difficult to carry out with consistent accuracy. It should be remembered that China Clay was one of the chief sources of the grit in a paper mill, causing abrasion of the machine wires and calenders. A few years ago the speaker described a modification of the well-known "beaker" method of sedimentation, based on Stokes' Law, in which all particles over 0·01 mm. were regarded as "grit." This separation was fairly sharp, the grit containing only very slight traces of clay, and the clay slight traces of grit; but he had now improved on this sedimentation method, and by means of the special but simple apparatus described, it was possible to estimate the grit in ten grams of clay very accurately in about one hour, using not more than four or five litres of water. With a five-gram sample the water could be reduced to about 3·5 litres. The advantage of this was obvious to those having experience of such work.

Colloidal Properties.—The colloidal properties of China Clay depended upon surface action and were therefore chiefly connected with the size of the particles. This could be measured directly by means of the microscope, using high magnification (1,000 diameters). The clay, after removal of grit by sedimentation, might also be fractionised by elutriation, but this was a long and tedious process. A much more satisfactory and quicker method of estimating particle size was the pipette method, now standardised in this country for agricultural analysis of clay. The absorption of aniline dyes might be used as a means of estimating the surface action by saturating a sample in a standard solution of the dye, drawing off on a Buchner filter, and washing the absorbed dye out of the latter with alcohol. The alcoholic solution of the absorbed dye was then diluted to a standard volume and measured colorimetrically. Another physico-chemical method of measuring the surface activity consisted in saturating the dry sample of clay with dry ammonia gas or dry sulphur dioxide. The sample after saturation was immediately transferred to water, and the absorbed gas titrated directly with suitable standard solutions. It would be found that the presence of small amounts of impurities in the clay, such as iron and organic matter, affected the surface activity, while not affecting the size of the particles. The size of particles played an important part in the carrying power of a clay; but high surface activity was desirable in clay for fine papers, to obtain uniformity of colour and sizing. Coarse grained clays were necessary for high speed running, but in fine papers the more highly colloidal the clay the better the results. There was no reason for the difficulties experienced by some papermakers in getting very fine clays to carry in the paper, if proper attention was given to the degree of acidity of the white-water.

Discussion

Mr. J. W. Berriman said that in his opinion Mr. Strachan had certainly not exaggerated the damage caused by grit, not merely to the finished paper and the printing machine, but also to the papermaking machine. Regarding the estimation of the fineness of China Clay by elutriation, due consideration should be given to the grade of paper for which the clay was required. Taking fast running stock and low grade of clay, papermakers would have to reject grit and the very finest fractions, and consider the quantity of intermediate clay which would be retained to good effect by the stock in question. The finest clay would largely be lost in drainage. In finer grades of paper, clays in the finest stat of division were

undoubtedly the most suitable. Mr. Berriman emphasised the need for a standard apparatus for the grit estimation in fine grade clays.

Dr. J. L. A. Macdonald said that, as the lecturer had pointed out, China Clay had to be considered not only from the point of its suitability as a loading material as regards freedom from grit and other harmful ingredients, but also from the point of view of the surface characteristics which it imparted to the paper. This latter problem was one about which little was known, but it was a typical example of the kind of problem meriting the attention of members of the section.

Carrying of Clay

Mr. Strachan, replying to Mr. Doig, stated that the carrying of clay mostly depended on the beating of the stuff. A fine clay would not carry well in very free stuff; the particles of clay would pass through the fibres and be lost in the back water. Generally speaking, a fine grade of clay carried best; that is, one that remained a long time in suspension, while for free stock or high speeds a coarse clay carried better. It was really a filtration problem. Fine stock well beaten at slow speeds formed an efficient filter to retain the clay, while free open stock allowed it to pass through. For free open stock a coarse, quickly-settling clay carried best, as the larger particles were better retained. An important point in connection with the retention of highly colloidal clays in wet stock was the amount of precipitated alumina present, as this had an opposite electrical charge to that of the clay; consequently the fibre produced coagulation and precipitation of the clay along with size and colour in flocculent masses between the fibres. The latter lying closely together in well-beaten stock held the precipitate.

Mr. J. Reid pointed out that elutriation tests being carried out with plain water were not strictly comparable with the conditions obtained in the mill, and it would be interesting to know what results were obtained when mill conditions were imitated, and similar chemicals were present.

He also felt that Mr. Strachan had not been able to do justice to the second portion of his lecture during the time allotted to him, and he hoped that he would return at a later date to continue the discussion of that section.

Major Aitken gave an indication of the graph formed by the settling of a 10 per cent. suspension of a normal China Clay, and referred to Mr. Strachan's mention of the application of high power microscopy to the measurement of particle size in China Clay. He (the chairman) said that in this method of measurement he had found the use of photo-microscopy invaluable.

With regard to the use of photo-micrography Mr. Strachan, in his reply, fully approved of this method of microscopy as a means of recording results and comparing them, and referred to high-power microscopy as a means of accurate measurement in the hands of those thoroughly capable of understanding it. The photo-micrograph in all branches of microscopy was an invaluable record.

February Deliveries

THOUGH February was a short month it showed an increase in total trade of nearly 5,000 tons over that of January, revealing the fact that trade is gradually on the increase, and that the extraordinary stocks taken in in December, when the total deliveries reached a record monthly figure of over 91,000 tons compared with the corresponding month of last year, are gradually getting exhausted. Both deliveries of China Stone and Ball Clay showed increases on the corresponding month of last year, but there was a drop of 11,000 tons in China Clay. The total deliveries in all three classes for the two months this year have reached 149,811 tons compared with 159,713 tons in the first two months of last year, a decrease on the year, so far, of 9,902 tons. Details:—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total Tons.	
Port.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.
Fowey.....	54,954	66,422	4,033	3,154	2,563	1,558	61,550	71,134
Charlestown	2,615	4,413	—	—	—	—	2,615	4,413
Par.....	4,858	3,164	—	—	—	—	4,858	3,164
Penzance..	1,190	808	—	—	—	—	1,190	808
Plymouth..	1,287	597	—	12	—	—	1,287	609
Falmouth..	130	180	—	—	—	—	130	180
Looe.....	—	195	—	—	—	—	—	195
By rail	5,282	5,552	—	—	—	—	5,282	5,552
February ..	70,316	81,331	4,033	3,166	2,563	1,558	76,912	86,055
January ...	65,955	66,760	4,375	3,742	2,569	3,156	72,899	73,658
Two mos.	136,271	148,091	8,408	6,908	5,132	4,714	149,811	159,713

Clay and Clay Products

Their Refractory Aspect Discussed

IN the course of an address on "The Story of Clay Products" at the Halifax Rotary Club, Mr. Herbert Oates discussed the industrial and practical aspects of clay mainly used in the production of refractory materials and articles, with some reference to the deposits in the locality.

Colour No Criterion of Quality

Clay, he said, is a popular term for a variety of substances of varied origin, of great variety in their composition and in many of their chemical and physical properties, and differing greatly in almost every respect. In colour it is extremely varied, ranging from almost pure white through all shades of yellow, red, brown, and black. The yellow clay is found chiefly under the surface, but the grey and greyish brown is the predominant colour. The natural colour of the clay is no criterion of its purity—some of the darkest coloured clays producing a pure white on burning, but this chiefly depends on the iron compounds found in the clay, some producing buff, red, or blue articles. The greatest physical property of clay is its plasticity, from which it is possible to produce the finest ornaments and other varied articles. Some of the manufacturers to increase this plasticity allow the clay to stand after being pugged for weeks and months in cold storage, and claim that by doing this they get better results with their manufactured goods.

How Shrinkage Difficulty is Overcome

The shrinkage of clay whilst on the drying floors and under fire is a very critical matter; the variation between the actual article made in the clay state and the actual article burnt in the finished state is as much as one inch to the foot, and great care has to be taken in proper allowance being made when arranging for the different moulds. To get over the difficulty of shrinkage burnt clay or grog has to be used with the raw clay when pugging and preparing for use. Halifax and district is richly served in clay minerals, and the clay which is produced is made up into the finest refractory and sanitary goods in the market and are known throughout the world.

Alumina and Silica Constituents Value

A specially selected clay in the Halifax area, being very rich in alumina, is used in some of the finest glazed bricks, and sanitary ware is produced with this material. It is also a clay which takes a good salt glaze, and is extensively used for the manufacture of sanitary pipes from 2 in. to 36 in. diameter, salt-glazed sinks, white glazed sinks, etc. As the Halifax clay is very rich in silica and produces the finest refractory goods on the market for retorts and bricks for gasworks, blocks for glass works, and ingots for steel works, etc., in a lower strata we come to a darker section of the clay termed soft bed about 2 ft. 6 in. thick, with a seam of excellent coal about 1 ft. 6 in. thick, which is in great demand for wire-works and blacksmiths' smithies. This clay is of a vitreous nature, and can be used for stoneware goods, but very little is used in the district as not many firms get down to this depth. The clays used for this important industry were deposited during what is known in geology as the carboniferous period, at the time when our coal seams were being laid down, and when plant and animal life were in such intermittent and prolific abundance, together with an excess of vegetation, the clay being the seat earth upon which the abundant forests grew. During the intervals of time between the laying down of one seam and another the whole forests became submerged with water. Thus we get the shales, which are huge mud deposits, and it is from these that our building bricks are made. Previous to this geological period was one during which great layers of rock were formed. These are now known as the millstone grits.

The Indispensability of Clay

What is made of clay to-day I have already instanced; common bricks, buff facing bricks, glazed bricks, tiles of all colours, terra-cotta goods, roofing tiles, chimney-pots, baths, sinks, w.c.'s, urinals, sanitary goods for hospitals, schools, etc., firebricks and blocks, gas retorts, furnace linings, and refractory goods in connection with the steel, iron, glass, and gas industries. The average output of common bricks previous to the war was 2,800,000,000, and last year it totalled about 5,100,000,000.

China Clay Notes and News

Imports of Coated Papers

The imports of coated papers increased from 151,067 cwt. in 1925 to 192,332 cwt. in 1926. Germany sent 64,540 cwt. (61,462 cwt. in 1925); Belgium, 54,622 cwt. (35,845 cwt. in 1925); France, 9,299 cwt. (14,289 cwt. in 1925); U.S.A., 8,440 cwt. (5,834 cwt. in 1925); Canada and other countries, 55,431 cwt. (33,637 cwt. in 1925).

China Clay as De-Inking Agent

L. E. GRANTON. U.S. Patent 1,585,092. MAY 18, 1926.—After pulping in water containing alkali or alkaline-reacting substances, printed paper is agitated with mineral substances having detergent properties, *e.g.*, soapstone, talc, China Clay, fullers earth, kieselguhr, or silica powder, which have been colloidalised by grinding and treating with casein, gelatine glue, albumin, gum arabic, gum tragacanth, starch, dextrin or similarly acting substances.

Tehidy Minerals, Ltd.

Speaking at the annual meeting of shareholders of Tehidy Minerals, Ltd., Sir H. Montagu Roberts said last year's disastrous labour dispute had left its blighting mark on all industrial concerns to which coal was a necessity. The China Clay trade, as well as all tin mines, was subjected to "this creeping paralysis," and he added that 1926 promised to be a "bumper" year for the China Clay industry, and down to the beginning of the coal strike there was an increasing demand for the clay. Tehidy Minerals, Ltd., possessed extensive China Clay areas, from which they received an income of over £4,000 in 1926.

Clay Pit to City Councillor

From the China Clay pits at the age of nine, when he earned a few pence a day, to a seat on the Truro City Council at 71—that is the story of Mr. Samuel Dyer, who has left the city to return to live at St. Austell, in which district he was born. "I lost my father when I was four," says Mr. Dyer. "Most of my education I obtained at a night school. From the clay pits I went to an insurance company and was later made a district superintendent. I retired in 1915 at the age of 60."

Mr. Dyer has been a local preacher since 1879, and has been president of the Truro Free Church Council and treasurer of the West Cornwall Federation of Free Churches. He is related to the Dyer family, who were amongst the pioneers of the China Clay industry. The late "Capt." Samuel Dyer was his brother, the present head of the firm ("Capt." Samuel J. Dyer) being Mr. Dyer's nephew.

Thefts from China Clay Works

At a special police court at St. Austell, John Long, married, 54 years of age, clay labourer, Mount Stamper, Bugle, pleaded "guilty" to the theft of one overcoat, value 10s., the property of Horace Bennetts, and also to stealing one coat and one pair of gloves, the property of Ernest Knowles. Horace Bennetts, clay labourer, Trethowal, said that he missed his overcoat at the clay dry at which he worked on Friday, February 4. He identified the overcoat produced in court as his property. Ernest Knowles, clay labourer, Trethowal, said that he missed the coat and gloves produced in court on the same date. The accused, who expressed his regret, was fined 5s. for each offence, and ordered to pay the costs. Messrs. W. Boxhall and Arthur Rowett, who were the magistrates, said that these offences of stealing things from clay works must be stopped, and if any other cases of such a character came before them they would deal with them more severely.

Big Canadian Newsprint Project

The Bathurst Co., Ltd., of Canada, have completed their plans for an expenditure of approximately $5,000,000 during the next few years. Keen interest has been demonstrated in the Maritimes in the proposed development, which provides for a hydro-electric project and an increase in the Bathurst Co.'s facilities for the production of newsprint. The present capacity is 75 tons a day, ultimately growing to 100 tons. It is only just recently that the Bathurst Co. has been producing newsprint at all. Their former production was confined to lumber and pulp. Mr. Angus McLean, president and general manager of the company, has announced that the new hydro-electric development will provide probably 50,000 horse power, which will be necessary to operate the new mill. It is expected to see the new mill operating within two or three years, with intermediate productions of 200 and 450 tons daily. Work will be provided for about 1,000 men during the period of construction.

China Clay Association Hopes

In thanking Miss Williams for her kindness in coming to open the public free library at St. Austell in premises placed at the disposal of the committee by the Y.M.C.A., Mr. A. J. Perry (who was the secretary of the committee that last year took steps to set up the new association of the China Clay industry) spoke of the great interest her father (the Lord Lieutenant of Cornwall—Mr. J. C. Williams, of Caerhayes Castle) took in the welfare of the town and district of St. Austell. He instanced Mr. Williams' efforts last year in trying to get the clay trade on a sounder footing. Mr. Williams, said Mr. Perry, did it not so much to help the clay proprietors, and goodness knew they needed help as much as anybody, as for the benefit of the working classes, and people who depended on it for their livelihood day by day. They appreciated very much the Lord Lieutenant's help to the industry. Although the project came to nothing, he expressed the hope that from the good seed sown they might reap the benefit later on.

Fowey Harbour Oil Nuisance

Following on the complaint of oil in Fowey Harbour, the clerk at the last meeting of the Fowey Town Council reported the receipt of a letter from the Mercantile Marine Department of the Board of Trade asking for full information as to the extent of the pollution since December, 1924, and other details. The Mayor stated that a similar letter had been received by the Harbour Commissioners. The Commissioners were doing their very best in the matter which, he agreed, was serious. Councillor Beale said there was a shocking instance of oil pollution in the harbour a short time ago. If the same thing had occurred in the Thames or the Mersey there would have been serious trouble about it, but at Fowey nothing was done. He was speaking on behalf of the ratepayers. Their ladders and slips were damaged and the men found their cleaned or newly painted boats dirtied by the scum. The Council decided to send a letter to the Board of Trade Department in support of the Fowey Harbour Commissioners' letter.

Cornwall Employment Figures Better

Since the general strike the figures of unemployment in the principal centres, Redruth, Camborne, Falmouth, Hayle, Penzance, and St. Austell, have shown a fairly consistent improvement, especially during the last few weeks. This improvement is the result of the rise in the price of tin and the activity in the China Clay industry. It is to be hoped that conditions will continue to improve and that by the gradual absorption of the workers, distress will be relieved over the remainder of the trying winter period. The totals at the various exchanges are:—Redruth, 442; Camborne, 477; Fowey, 115; Hayle, 307; Helston, 58; Newquay, 25; Penzance, 340; Perranporth, 1; St. Austell, 450; St. Columb, 65; St. Just, 159; Truro, 134. Of the above numbers 373 men, 1 boy, 115 women, and 9 girls are known to be working short time, or stood off temporarily, or in casual employment.

Road Maintenance Expenditure Continues

At the St. Austell Rural Council meeting for approving the estimates of expenditure for the ensuing half-year, the surveyors submitted their estimates as follows:—Eastern district, £14,196; Western district, £14,230 17s.; total, £28,426 17s.; as compared with the following amounts last year—viz., Eastern district, £14,196; Western district, £14,266 10s. 9d.; total, £28,462 10s. 9d. Mr. T. Nicholls, who is associated with the China Clay trade, referring to the letter of protest from the China Clay merchants with reference to the rates, asked whether it was not possible to do with a smaller amount this coming half-year having regard to the serious financial position of the industry. Mr. Maunder, the surveyor, explained that there was no prospect yet of their reducing their expenditure on the roads, the object being to get them up to a standard for classification to qualify for the Ministry of Transport's grants. He admitted that some of the roads were improved, but more money must be spent on them to get them up to the required standard.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—February, 1927

Arrived.	Name.	Sailed.	Destination.
February 1,	s.s. *Primrose*	February 8,	Runcorn
February 1,	s.s. *Dorset Coast*	February 3,	Preston
February 1,	s.s. *Harptree Combe*	February 9,	Runcorn
February 2,	m.v. *Lynher*	February 4,	Plymouth
February 2,	m.v. *Regina*	February 4,	Plymouth
February 2,	s.s. *Johanne Dybward*	February 9,	Portland, Me.
February 3,	s.s. *Enid Mary*	February 8,	Antwerp
February 3,	s.s. *Mersey*	February 9,	Preston
February 5,	s.s. *Enlymnor*	February 8,	Bo'ness
February 5,	s.s. *Pansy*	February 9,	Preston
February 5,	s.s. *Pembroke Coast*	February 10,	Weston Pt.
February 5,	s.s. *Westerham*	February 10,	Antwerp
February 5,	s.s. *Overton*	February 9,	Ridham
February 5,	m.v. *Diligent*	February 11,	Gweek
February 6,	s.s. *Tommeliten*	February 12,	Harburg
February 6,	s.s. *Briar Rose*	February 10,	Manchester
February 7,	s.s. *Vera Kathleen*	February 11,	Portland, Me.
February 7,	s.s. *Condor*	February 12,	Terneuzen
February 8,	s.s. *Pylades*	February 12,	Leith
February 8,	s.s. *Johanna*	February 11,	Kirkcaldy
February 9,	s.s. *Blush Rose*	February 12,	Preston
February 10,	s.s. *George Allen*	February 18,	Boston & Phila.
February 10,	s.s. *Ardri*	February 14,	Preston
February 10,	s.s. *Solskin*	February 12,	Fredrikshald
February 10,	s.s. *Horn*	February 18,	Rouen
February 10,	s.s. *Wheatvale*	February 12,	Cardiff
February 10,	s.s. *Gower Coast*	February 15,	Birkenhead
February 11,	m.v. *Lydia Gardell*	February 18,	Rouen
February 12,	s.v. *Greenhithe*	February 14,	Charlestown
February 12,	s.s. *Haardraade*	February 15,	Bilbao & Pas's.
February 13,	s.v. *Wellington*	*	
February 13,	s.v. *Urda*	*	Karlskrona
February 14,	s.s. *Cisneros*	February 16,	Genoa
February 15,	s.s. *Jolly Guy*	February 19,	Ridham
February 15,	s.s. *Hayle*	February 17,	Runcorn
February 15,	m.v. *Laanemaa*	February 19,	Reval
February 15,	s.s. *Baron Ruthven*	February 19,	Philadelphia
February 16,	s.s. *Cambulu*	February 19,	Liverpool
February 16,	s.s. *Exeter City*	February 24,	Philadelphia
February 16,	s.s. *Bonawe*	February 17,	Charlestown
February 16,	m.v. *Wietz*	February 21,	Goole
February 16,	s.s. *Joffre Rose*	February 21,	Weston Point
February 17,	s.s. *Pansy*	February 22,	Runcorn
February 17,	s.s. *Percy*	February 23,	Grangemouth
February 17,	s.s. *Primrose*	February 26,	Weston Point
February 17,	m.v. *Mayblossom*	February 18,	Plymouth
February 17,	m.v. *Wilhelm Luhring*	February 24,	Granton
February 18,	s.s. *T. P. Tilling*	February 19,	Charlestown
February 18,	m.v. *Katie*	*	Rochester
February 19,	s.v. *Waterwitch*	*	Newcastle
February 19,	s.s. *Wheatcrop*	February 24,	Barrow
February 19,	s.s. *Christina*	February 25,	Grimsby
February 19,	s.s. *Kingsley*	February 24,	Swansea
February 19,	s.s. *Ferndene*	February 25,	Antwerp
February 19,	s.s. *Orione*	February 26,	Genoa
February 19,	s.v. *Omen*	*	Gothenborg
February 19,	s.s. *Stock Force*	February 25,	Preston
February 19,	m.v. *Annie*	February 24,	Charlestown
February 19,	s.s. *Zaanstroom*	February 23,	Amsterdam
February 21,	s.v. *Jens Nielsen*	*	Fredrikshald
February 22,	s.s. *Glencregagh*	February 26,	Weston Point
February 22,	s.v. *W. E. Gladstone*	*	Plymouth
February 22,	s.s. *Bombadier*	February 26,	Terneuzen
February 23,	s.s. *Gottland*	March 1,	Brussels
February 23,	s.s. *Mersey*	February 26,	Runcorn
February 23,	s.s. *Robrix*	February 24,	Par
February 23,	s.v. *Mary Ann*	*	Runcorn
February 24,	s.s. *Audax*	February 27,	Leith
February 24,	s.s. *Guelder Rose*	*	Runcorn
February 24,	s.s. *Brier Rose*	March 1,	Weston Point
February 24,	m.v. *Agathe*	*	Drammen
February 24,	s.s. *Scartho*	*	Bilbao
February 25,	s.s. *Impoina*	*	Harburg
February 25,	s.v. *R. Passmore*	*	London
February 26,	s.s. *Horn*	*	Rouen
February 26,	s.s. *Gower Coast*	*	Liverpool
February 26,	s.s. *System*	*	Greenhithe
February 26,	s.s. *Hayle*	*	Weston Point
February 27,	s.s. *Gylfe*	*	Drammen
February 28,	s.s. *Mondara*	March 1,	Charlestown
February 28,	s.s. *Stanley Force*	*	

* In port.

Charlestown Shipping—February, 1927

Arrivals

Date.	Vessel.	From
February 5	s.s. *Ebbrix*	Teignmouth
February 5	s.s. *Walnut*	Newport
February 11	*Lady Rosebery*	Plymouth
February 14	s.s. *James Tennant*	Dartmouth
February 14	*Greenhithe*	Teignmouth
February 17	s.s. *Bonawe*	Barry
February 18	s.s. *Trader*	Truro
February 18	s.s. *Jolly Marie*	Plymouth
February 19	s.s. *Mourne*	Falmouth
February 20	*Snowflake*	Falmouth
February 24	*Annie*	Fowey
February 25	*Lady Agnes*	Mevagissey

Sailings

Date.	Vessel.	Destination.
February 8	s.s. *Ebbrix*	Northfleet
February 11	s.s. *Walnut*	Fleetwood
February 14	*Lady Rosebery*	London
February 15	s.s. *James Tennant*	Rochester
February 16	*Greenhithe*	Dartford
February 18	s.s. *Jolly Marie*	Gravesend
February 19	s.s. *Trader*	Tayport
February 19	s.s. *Mourne*	Runcorn
February 22	s.s. *Bonawe*	Glasgow
February 23	*Snowflake*	Runcorn
February 28	*Annie*	Salcombe

Penzance Shipping—February, 1927

Arrived.	Name.	Sailed.	Destination.
February 3,	s.v. *Louise Ernest*, of Jersey.	February 17,	Rochester
February 7,	m.v. *Lutt*, of Hamburg	February 11,	Gothenburg
February 7,	s.v. *Mary Barrow*, of Barrow	March 2,	Rochester
February 8,	s.v. *Alert*, of Falmouth	February 15,	Rochester
February 21,	s.s. *Nancie Thomas*, of Liverpool	February 24,	Rochester

Par Harbour Shipping—February, 1927

Arrivals

Date.	Vessel.	From
February 1,	m.v. *Johanna*	Penzance
February 3,	s.s. *Vilvorde Maritime*	Truro
February 3,	s.s. *Patisonian*	Dartmouth
February 3,	m.v. *Capable*	London
February 3,	s.v. *Mary Ann Mandal*	Truro
February 3,	s.s. *Pamela*	Jersey
February 4,	s.s. *Treleigh*	Portreath
February 4,	s.s. *Elsie Thomas*	Newport
February 4,	s.s. *Knowl Grove*	Salcombe
February 7,	s.v. *Gauntlet*	Cardiff
February 8,	s.s. *Solskin*	St. Malo
February 8,	s.s. *Robrix*	Teignmouth
February 8,	m.v. *Kate*	Plymouth
February 11,	m.v. *Isabel*	Poole
February 15,	s.s. *Treleigh*	Portreath
February 16,	s.s. *Edenside*	Plymouth
February 16,	s.v. *Henrietta*	Porthoustock
February 17,	m.v. *Kate*	Falmouth
February 17,	m.v. *Hamme*	Salcombe
February 17,	m.v. *Iron King*	Plymouth
February 18,	s.v. *Brooklands*	Falmouth
February 18,	s.v. *Flying Foam*	Porthoustock
February 19,	s.s. *Grosvenor*	Plymouth
February 19,	s.s. *Sandholm*	Salcombe
February 24,	s.s. *Robrix*	Plymouth
February 24,	s.v. *S. F. Pearce*	Truro
February 26,	s.v. *Englishman*	Truro

Sailings

Date.	Vessel.	Destination.
February 2,	s.v. *Ivy*	Queenborough
February 4,	s.s. *Patisonian*	London
February 5,	s.s. *Vilvorde Maritime*	Antwerp
February 5,	m.v. *Capable*	Rochester
February 5,	s.s. *Treleigh*	Preston
February 6,	s.s. *Pamela*	Preston
February 8,	m.v. *Johanna*	Kirkcaldy
February 8,	s.s. *Knowl Grove*	London
February 9,	s.s. *Elsie Thomas*	Garston
February 9,	s.s. *Robrix*	Gravesend

February 10, S.S. *Solskin*	Fowey
February 13, M.V. *Kate*	Plymouth
February 15, S.S. *Treleigh*	Preston
February 16, S.V. *Mary Ann Mandal*	Rochester
February 16, M.V. *Isabel*	Poole
February 17, M.V. *Kate*	Plymouth
February 18, S.S. *Edenside*	Newcastle
February 18, M.V. *Iron King*	Plymouth
February 19, M.V. *Hamme*	Leith
February 24, S.V. *Henrietta*	Queenborough
February 24, S.S. *Grosvenor*	Lancaster
February 24, S.S. *Sandholm*	Antwerp

Par Harbour Tide Table, April, 1927

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Friday	1	4.37	5.0	13.8
Saturday	2	5.23	5.40	14.1
Sunday	3	6.8	6.29	14.6
Monday	4	6.50	7.10	14.6
Tuesday	5	7.29	7.49	14.1
Wednesday	6	8.10	8.31	13.2
Thursday	7	8.51	9.12	12.0
Friday	8	9.34	9.59	10.10
Saturday	9	10.29	11.5	9.9
Sunday	10	11.47	—	9.2
Monday	11	0.34	1.19	9.4
Tuesday	12	2.0	2.36	10.0
Wednesday	13	3.8	3.35	10.10
Thursday	14	3.58	4.19	11.7
Friday	15	4.38	4.55	12.2
Saturday	16	5.12	5.28	12.6
Sunday	17	5.43	5.58	12.8
Monday	18	6.13	6.28	12.10
Tuesday	19	6.43	6.57	12.9
Wednesday	20	7.11	7.26	12.5
Thursday	21	7.42	7.58	12.0
Friday	22	8.14	8.32	11.5
Saturday	23	8.52	9.14	10.2
Sunday	24	9.39	10.08	10.1
Monday	25	10.42	11.21	9.8
Tuesday	26	—	0.5	9.9
Wednesday	27	0.51	1.35	10.6
Thursday	28	2.13	2.46	11.8
Friday	29	3.15	3.41	12.9
Saturday	30	4.6	4.11	13.7

E. CLEMENS, Harbour Master.

China Clay Exports for February, 1927

RETURN showing the exports of China Clay, the produce of the United Kingdom, from the United Kingdom to each country of destination as registered during the month ended February 28, 1927:

COUNTRY OF DESTINATION.	QUANTITY. Tons.	VALUE. £
Finland	1,370	2,238
Sweden	1,070	1,666
Norway	464	594
Germany	1,585	3,380
Netherlands	3,308	6,884
Java	2	4
Belgium	3,247	5,270
France	925	1,497
Portugal	—	3
Spain	1,007	2,436
Italy	2,298	5,567
Bulgaria	1	11
China	5	27
United States of America	20,506	39,892
Peru	20	46
Brazil	20	103
Argentine Republic	405	2,303
Nigeria	—	3
Cape of Good Hope	673	1,301
Transvaal	—	1
Bombay, via Other Ports	1,944	8,431
Madras	15	69
Bengal	481	1,578
Burmah	10	35
Australia	16	91
New Zealand	1	8
Canada	27	57
Irish Free State	—	1
Total	39,400	83,496

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an*—followed by the date of the Summary, but such total may have been reduced.*]

BONES GATE BRICK AND TILE CO., LTD., Ewell. Registered February 18, charge, to Bank; charged on Far Marles, Chessington.

FLINTFORD BRICK AND TILE CO., LTD., Frome. Registered February 3, £1,000 debenture, to A. M. G. Daniel, Frome, solicitor; general charge.

FONTLEY BRICK AND TILE CO., LTD. Registered February 24, £6,800 debenture (supplemental to debenture dated May 29, 1925, as additional security for £6,800 primarily secured in a mortgage by an individual), to S. Brutton, 124, High Street, Portsmouth; general charge (including company's leasehold and freehold property, acquired previously and subject to prior charges). *£14,950. June 29, 1926.

SLACK (JOHN), LTD., Hayfield, paper manufacturers. Registered February 5, £8,300 debenture, to N. Slack, The Oaklands, Hayfield; charged on Bank Vale Paper Mills and other properties at Hayfield, also general charge (subject to debenture below); also registered February 8, debenture, to Bank; charged on Bank Vale Paper Mills, Hayfield, also general charge. *£7,574 4s. 2d. June 25, 1926.

WINKLE (F.), AND CO., LTD., Stoke-on-Trent, earthenware manufacturers. Registered February 16, £4,000 2nd debenture, to C. T. T. Forrester, 1, Baker Street, Fenton, and another; general charge. *£8,000. October 28, 1926.

Satisfactions

COLTHROP BOARD AND PAPER MILLS, LTD., London, S.W. Satisfaction registered February 4, £65,000 (not ex.), registered March 30, 1922.

FOREST CHINA CLAY WORKS, LTD., London, E.C. Satisfaction registered February 5, £5, registered January 28, 1926.

GLENFIELD "PREMIER" BRICK AND TERRA COTTA CO., LTD. Satisfactions registered March 1, £6,650, registered October 25, 1921; and £350, registered August 21, 1923.

HILL PALMER AND CO., LTD. (late PALMER AND HEWS, LTD.), London, E.C., paper manufacturers. Satisfaction registered February 10, £100, part of amount registered September 25, 1924.

RIDGWAYS (BEDFORD WORKS), LTD., Stoke-on-Trent, pottery manufacturers. Satisfaction registered February 21, £1,000, part of amount registered September 30, 1922.

RIDING AND GILLOW, LTD., Stacksteads, bleachers, etc. Satisfactions registered February 15, £4,000, balance of amounts registered May 6, 1910, and May 27, 1913; and £1,500, registered June 14, 1921.

SLACK (JOHN), LTD., Hayfield, paper manufacturers. Satisfactions registered February 7, £4,000, balance of amount registered March 14, 1910; and £8,000, registered December 28, 1921.

China Clay Imports for February, 1927

A RETURN showing the Registered Imports of China Clay, including China Stone, into Great Britain and Northern Ireland from the several countries of consignment during the month of February, 1927, indicates that 437 tons, value £907, were imported from the Channel Islands.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

The First Three Months

THOSE directly interested as producers and merchants in the China Clay industry have no need to be discouraged by the slow progress revealed by the turnover in the various classes of products for the first three months of the year, as disclosed by the statistics published elsewhere. Compared with the first three months of last year, the total deliveries are, it is true, down by nearly 20,000 tons, but there are several factors to account for this.

Explanatory Factors

In the first place, as we have previously mentioned, the big year end execution of orders, aggregating over 91,000 tons in the single month of December, a very remarkable record for the last month of the year, was in anticipation of the requirements in the first three months of this year at last year's prices. The average quantity for a December month is 60,000 tons, so that if 30,000 or so of what was sent away in December is credited to the first three months of this year, it will be seen that the actual drop of 20,000 tons is not so serious as it looks on the face of it. Another fact that must be borne in mind when considering comparative figures of a year ago is that the threatened coal strike was looming in the near distance, in anticipation of which consumers were buying beyond immediate requirements last year.

The first few months of the year are always an uncertain period for the China Clay trade. After that the Baltic, Canadian, and North American ports become more accessible for traffic, and have a considerable influence on the markets in Norway, Sweden, Finland, and Northern Russia countries particularly. Reports show that already orders from these countries are being received and executed.

European Markets Expansion Prospects

The markets in Northern Europe are capable of a good deal of expansion, and should now respond to the more favourable economic conditions prevailing for the shipment of supplies. Belgium markets may not show very considerable further expansion, in view of the already big recovery they have made to pre-war volume, but there is room for a big increase of business in France, which has been slow to overcome the setbacks experienced since the war. The reopening of the German markets has been one of the most encouraging features of the overseas trade in the last eighteen months. Their recovery to the pre-war level of 80,000 to 90,000 tons per annum would give a great impetus to the home China Clay industry. These markets are the ones which give the greatest hope of the most substantial addition to the volume of exports to European countries; and, in fact, to overseas countries generally, for, with the big tonnage that has now been reached on United States account, it is difficult to see much justification for anticipating any substantial increase this year on last year's total.

Best and Common Clays in Favour

Reports from various quarters indicate that the clays that have been enjoying the biggest demand are the best and common. In both these classes prices show a tendency to rise; at any rate, there does not appear to be any prospect of any lowering of prices in these grades as the year advances. Ball Clay markets are holding their own very well. They now have to contend with unrestricted supplies of China Clay of all grades, different from the pre-China Clay Association days, when the competition was not so keen for Ball Clay producers. China Stone is enjoying fairly good markets, doubtless accounted for by the gradual improvement in the ceramic industry. It shows an increase on the three months of over 1,300 tons, which is indicative of a growing demand.

Rating of China Clay Works

AT the meeting of the St. Austell Rural Council on Friday, April 1, the question of the rating of works arose. The Clerk reported having had a conversation with the valuer nominated by the committee for valuing the China Clay works and tin mines in the district in preparation for next year's rating to commence on April 1, under the new Rating and Valuation Act. It was stated that the initial quotation as to what this work would cost the council represented "thousands of pounds." Some discussion ensued, in which it was stated that the China Clay and similar undertakings would be rated on a different basis than formerly and that the new work of valuing them would be a big job and would have to be undertaken right away to be ready to be put into force next year.

Some reference was made to the appointment of the county valuer at £600 per annum by the county council, and it was stated that it was the intention of the council to get the assistance of the county valuer in the valuation of such places as cinemas and public-houses. Mr. R. Varcoe urged that they should consider carefully before they embarked on an expenditure of thousands of pounds in the appointment of a special valuer to deal with the clay works and tin mines. It was agreed that before the council commit themselves the fees that would be required by the special valuer should be submitted to the council at their next meeting a month hence.

Dyes and Colours on Colloidal Clay

A very important use of colloidal clay is in the "striking" of dyes and colours. When such substances as these are deposited on a base the resulting pigments are used for paints, enamels, etc., and any economy that can be effected by this method of preparation is of great value. By its properties colloidal clay is capable of effecting a great saving as a base and also in producing colours possessing greater staining power than has hitherto been obtainable. In lithographic inks and enamel paints a veritable revolution has been effected. It is obvious that the finer the state of division of a pigment and the greater its emulsification properties, so will the texture of the paint be smoother and the final appearance of the work better.

Effect of Heat on China Clay

Action on Surface Properties

KAOLINITE, as is known, decomposes at about 500° C., and loses its water of constitution, after which it is more soluble in acids. There is another change at about 900° C., and it then becomes acid proof. On the other hand, China Clay in the natural state always contains a certain amount of hygroscopic water which can only be removed by prolonged heating at 130° C., or more rapid heating at 250° C. Experiments made by R. Dubrisay to ascertain whether these various changes are associated with variations in the superficial properties are described in *Le Ciment*, December, 1926. For this purpose four samples of washed China Clay were treated as follows: The first sample was kept untouched, whilst the other three were heated for two hours at 250° C., 550° to 600° C., and 950° to 1,000° C. respectively, after which they were examined. Following a method given by M. Guichard, the experimenter spread small quantities of the four samples on watch glasses, which were then placed under a bell glass in the presence of an excess of iodine. After two days, samples one and two had developed a straw colour, whilst the third and fourth remained colourless. At the end of ten days samples one and two were brownish-yellow, and three and four straw colour. The absorptive power towards iodine thus decreased under the action of heat.

Absorption of Dyes

In further experiments, 1 gram of China Clay was put into 50 c.c. of a solution of 0·1 g. of methyl blue per litre of water, and agitated for two hours. With samples one and two there was a complete loss of colour, whereas in the case of samples three and four the colour remained, and the ratio of intensity of coloration measured by the colorimeter was $I_1 : I_2 = 50 : 7$. In a second experiment, 1 g. of samples one and two was placed in 100 c.c. of liquid. The solutions remained slightly coloured after agitation for two hours and the ratio of the colorations was $I_2 : I_1 = 36 : 34$. These results confirm and complete those of the preceding paragraph.

The heats of moistening with water and with an ammonia solution (one molecule per litre) of the four samples were then compared. Five grams of the powder were dropped quickly into a well-insulated vessel in which there was a thermometer dipping into 5 c.c. of liquid. The rises of temperature were as follows:

Sample.	Water.	Ammonia.
1	0·130°	0·245°
2	0·165°	0·270°
3	0·090°	0·210°
4	0·070°	0·060°

Volume of Water Absorbed

Five grams each of samples one, three, four were then placed separately in 10 c.c. of distilled water and the suspended particles kept in graduated tubes for five days when the volume V occupied by the solid saturated with water and the volume V^1 of the supernatant liquid were noted. The results are given in the following table:

Sample.	V	V^1	$\frac{V^1}{V}$
	c.c.	c.c.	%
1	9	2·75	30
3	8·50	3·25	38
4	8	4	50

As the volume of the liquid increases continually with the temperature to which the sample has been exposed, the capacity for absorption is obviously reduced by heating.

The same experiment repeated with a normal solution of ammonia gave the following results:

Sample.	V	V^1	$\frac{V^1}{V}$
	c.c.	c.c.	%
1	6·50	5·50	84
3	7·0	5	71
4	7·50	4	53

With the samples one and three the supernatant liquid was turbid and the volume greater than with pure water. This was not so with sample four, and it should be compared with the results obtained for the heat of moistening. Finally, in the case of lime water, the results were as follows:

Sample.	V	V^1	$\frac{V^1}{V}$
	c.c.	c.c.	%
1	9·75	2	20
3	9	2·50	27
4	9	3	33

The ratios for the three samples $\frac{V^1}{V}$ being less than with pure water, the presence of lime increases the capacity for absorption.

China Clay Co.'s Action

A Question of Commission Custom

AT the last Truro County Court, before his Honour Judge Gurdon, the hearing was concluded of the claims by the Great Rosemellyn China Clay, Ltd., London, for £68 11s. 10d., balance due on goods alleged to be delivered, against Chas. R. Skynner and Reg. C. A. Skynner, trading as Skynner and Higson, St. Austell.. The latter counter-claimed for £72 2s., commission on the alleged sale of clay at an agreed rate of 10 per cent. on £721 and rent of office. Mr. E. J. Coslett and Miss A. R. Vivyan, clerks, each sued the Great Rosemellyn China Clay, Ltd., for one month's wages, alleged to be due in lieu of notice. Mr. F. S. Laskey, barrister, instructed by Dunn and Baker, Exeter, was for the company, and Dr. H. Newcombe Wright, of St. Austell, was for the other parties. An account of part of the case was given in this supplement on February 19.

Mr. C. R. Skynner acquired the lease of a clay sett at St. Blazey and he and Mr. H. Gould, solicitor, Exeter, agreed to go into partnership and afterwards to float it as a limited concern, with Mr. Gould as chairman and Mr. Skynner a director. Mr. Skynner alleged in evidence that he was turned out of the company without any opportunity of defence, and at a meeting he had his witnesses who were kept outside by a policeman, and he was treated as a prisoner at the bar. It was not true that he tried to use the company for his personal profit. He sold the clay in the finest market in the world and did everything a mortal man could do, but he was "pulled to pieces by men who knew nothing about it." Mr. Gould only obtained £500 of capital, but he obtained £6,000 by his efforts.

Custom of the Trade

Mr. W. Rose, senior partner of North and Rose, St. Austell, gave evidence for the company that commission was never paid on the value of the clay sold, but on the basis of so much per ton. The output of China Clay in the area last year was about 900,000 tons, of which about 600,000 tons went abroad, America taking between 300,000 and 400,000 tons. Middlemen took a large share of the trade, and about 20 per cent. was sold through agents.

Mr. H. F. Gould, giving his version for the company, asserted that he put £1,000 into the concern, and also got £5,000. It was agreed that each should lend their clerks and offices free, and that the company should be put on sound financial basis before Mr. Skynner and himself touched a penny. He (witness) had not been paid anything for the preliminary expenses, and until the present action was commenced nothing was suggested as being due for offices expenses or salary. In 1925 Skynner and Higson were appointed sole selling agents for six months at an inclusive commission of 10 per cent. The directors always refused to consent to the repair of the car in question. There was never any arrangement that the clerks should be part time servants of the company, but it was arranged that payments should be made to Skynner and Higson for the extra work their clerks did. Following a certain report, there was an extraordinary meeting of the shareholders. Mr. Skynner was called upon for an explanation, but he said he knew nothing about it, and a resolution was passed dismissing him from the board.

Judgment was given for the plaintiffs (Great Rosemellyn China Clay, Ltd.) on the claim for £68 11s. 10d., and costs; for the defendants (Skynner and Higson) on the counter-claim for £55 18s. 10d., and costs; for E. J. Coslett for £8, and costs, damages for dismissal without notice; and for Miss Vivyan, one farthing damages for dismissal without notice, each of the parties in this action to pay their own costs.

China Clay Notes and News

St. Austell Estate of £27,000

Lt.-Col. Arthur Staniforth Hext, of Trenarren, St. Austell, chairman of St. Austell Bench, who died on November 12, aged 79, left unsettled estate of the gross value of £27,248, with net personalty £26,944. The testator left certain china and silver, and a pearl necklace, to devolve as heirlooms with the Trenarren Estate, and he confirmed the settlement made on his marriage. He left £5 to each in and outdoor servant of three years' service, and all his stocks and shares in trust for his wife for life, with remainder in trust for his daughter, Rhoda Marjorie, during her life, with remainder upon trust for his other daughters or their issue in equal shares. The residue of the property he left to his wife absolutely.

Canada's News Print Supremacy

Credit is due to the *Financial Counsel* of Montreal for an interesting treatment of the story of the passing of the newsprint sceptre into Canadian hands. "Apart altogether from the remarkable evidence of growth in production and in consumption of newsprint in Canada and the United States during the past year, the figures make it clear that the sceptre of supremacy as a world producer has passed from the hands of the United States into those of the Canadian mills. For the first time in history the year 1926 saw Canadian production exceed that of the United States. In 1925 Canada had almost reached her great rival, but ended the year 8,101 tons behind. By December 31, 1926, however, the Canadian total for the twelve months had swept ahead of that of the United States by 195,042 tons, the Canadian production reaching a total of 1,881,737 tons, and that of the United States 1,686,695 tons.

China Clay Merchant's Bereavement

Widespread sympathy has been extended to the family of Mr. J. W. Higman, J.P., of Polgray, St. Austell, on the death, in a London nursing home, of his second daughter, Miss Irene Higman. Miss Higman was the younger of the three daughters of Mr. Higman, who have been noted for their ungrudging service to all good causes in St. Austell for several years. During the war, Miss Higman rendered splendid service in the V.A.D., and since the war had engaged wholeheartedly in church and charitable work. She was a member of the St. Austell Hospital Committee. In everything Miss Higman took up she worked with a singleness of purpose that won for her the esteem of all with whom and for whom she worked. Her service to the community will be greatly missed, especially by those associated with her in church work. At the funeral, China Clay interests were represented, Mr. Higman being one of the directors of China Clay Producers, Ltd., and the senior partner in the firm of J. W. Higman and Co.

China Clay Works Unsold

There was a good attendance of China Clay merchants and others interested in the China Clay industry at the offer for sale in the St. Austell Lecture Hall, by Mr. N. F. Bellamy (of Bellamy and Duff), of the Alseveor and Trethurgy China Clay Works. The sale was by order of the receiver appointed by a debenture holder. Higman and Hubbard were the solicitors, and Mr. J. Keay, chartered accountant, was the receiver. The Alseveor Works embrace an area of about 37½ acres, and comprise the China Clay pit, about 100 feet deep, with 120 ft. shaft, the buildings and machinery, micas 130 ft. long and 12 runs wide, four settling pits and concrete water storage tank, and a pipe line from works to dry about 3,296 yards long. The dry is situated at Tregrehan. The Tregrehan works embrace an area of about 50 acres, and comprise the pit, about 65 ft. deep, with shaft 20 ft. deeper, buildings and machinery, micas 91 ft. long, with eight runs, four settling pits, three mica catch pits, mica runs and settling pit. The dry is situate at Garker. Plant and tools, and stocks of wet and dry clay were included in the sale, but the stocks were to be paid for by the purchaser at valuation, in addition to the purchase price. The works were first offered together and then separately, but no offer was forthcoming in either case. The properties were therefore withdrawn.

New Consolidated Mines of Cornwall

At the statutory meeting of the New Consolidated Mines of Cornwall, Ltd., held on Friday, April 1, the chairman, Mr. Henry Van den Bergh, in presenting the report, said that the whole of the 5,000 shares at present issued had been applied for and allotted and the sum of 10s. paid up on each share. Referring to the company's operations, the chairman said that—so far as could be seen by the results of the first two months' trading in Cornwall—the removal of the organisation from London to the centre-point of the industry was justifying itself to the fullest extent. Not only could a far better control be exercised over the numerous qualities of clay offered and sold, but also the shipments could be properly supervised and more direct attention paid on the spot to customers' requirements. Many of the difficulties experienced in the past had been due to the lack of these important facilities and, judging from the satisfactory amount of business which the company was already doing, and the increasing number of new orders that were being received, the new arrangement appeared to be giving general satisfaction. Given a fairly normal period of trading ahead, without any strikes or other serious industrial disturbances to cause a setback, there was every reason to look forward with confidence to the future development of the business. Possession of the new offices secured in Duke Street was being taken on the following day, and with the increased accommodation which they provided, the company's programme of expansion could now be tackled to the fullest extent.

Dental Porcelain

When porcelain is used in the manufacture of artificial teeth the requisite materials are employed in different proportions, and various methods are adopted. In one of the latter the felspar is crushed, hand picked, and ground in a dragmill. The ground felspar is mixed with kaolin, quartz, and a little starch and gum. Various oxides are employed to tint this mixture. The teeth are made in bronze moulds, paste of the desired colour being laid on to the different parts of the mould. In order to bake the mixture lightly, the mould with its contents is heated under pressure. On the removal of the teeth they are dressed and burned in a gas muffle on trays made of fused silica. To ensure external fusion without warping, the teeth are submitted to the shortest heating permissible; annealing in a separate furnace follows. When the metal pins, employed to fix the teeth to the plate, are made of platinum they are inserted prior to burning the teeth. On the other hand, when pins of base metal are introduced, they are usually soldered to platinum tips after the teeth are burned. Experiments on the manufacture of dental porcelain at temperatures sufficiently high to permit of base metal pins being burnt in the teeth have not proved satisfactory.

The following are some of the porcelain compositions in commercial use:

1. Felspar, 81; clay substance, 4; and flint, 15 per cent.
2. Felspar, 80; quartz, 20; bone ash, 5 per cent.
3. Felspar, 89; flint, 3·8; sodium carbonate, 4·0; calcium carbonate, 2·7 per cent.
4. Felspar, 61·06; flint, 29·07; sodium carbonate, 1·86; calcium carbonate, 4·21; potassium carbonate, 1·98; borax, 0·83 per cent.
5. Felspar, 12·02; flint, 60·49; sodium carbonate, 7·90; calcium carbonate, 7·21; borax, 10·95 per cent.

The employment of porcelain (silicate) cements has almost entirely superseded the use of genuine porcelain for dental inlays. These cements consist of a powder composed of basic calcium and aluminium silicate (occasionally with the admixture of beryllium nitrate), zinc oxide, and calcium aluminate treated with a special liquid. The latter consists of a modified solution of phosphoric acid.

The following is the analysis of a silicate cement in commercial use: Silica, 37·0; alumina, 32·2; calcium, 10·1; phosphorus, 1·9; and fluoride, 1·3 per cent. On ignition, the loss should be about 2·0 per cent.

The liquid employed with the cement consists of sodium 6·0, phosphorus 35·5, and water 58·5 per cent.

China Clay Chemist's Wedding

Miss Clarisse Martin Hancock, elder daughter of Mr. and Mrs. E. J. Hancock, of Bay House, St. Austell, and Mr. Evan Joseph Lewis, M.Sc., A.I.C., son of the late Capt. Owen Lewis, of Aberavon, Cardiganshire, were married at the Parish Church, St. Austell, recently. After the ceremony Mr. and Mrs. Lewis left for the South of France for the honeymoon. The bridegroom, who is an analytical chemist and China Clay technologist, has been associated with the West Carclaze, Mid-Cornwall, and the Beacon China Clay Companies. He is a nephew of Mr. J. P. Carter, of Fowey, managing director of Toyne, Carter and Co., Ltd. (the well-known shipping brokers and agents to the Direct Clay Lines), and is also a member of the St. Austell Rotary Club. The gifts received by Mr. and Mrs. Lewis included cheques from the West Carclaze China Clay Co., the Mid-Cornwall China Clay Co., and Beacon Clays, Ltd.

Clay Products in Canada

The production of clay and clay products in Canada during 1925 was valued at $9,329,691, according to finally revised statistics just issued by the mining, metallurgical, and chemical branch of the Dominion Bureau of Statistics at Ottawa. This year's sales were 3·4 per cent. higher than the total of $9,215,077 reported for 1924. The Ontario production in 1925 was valued at $5,195,084, or 54·5 per cent. of the total for Canada. Quebec came next with a sales value of $2,426,887. Alberta, British Columbia, Nova Scotia, Manitoba, Saskatchewan, New Brunswick, and Prince Edward Island followed in the order named. Capital employed in the 190 plants, including cost of properties, equipment, and stock on hand, cash and collectable accounts, amounted to $27,760,864. Employment was furnished 310 salaried employees and 3,826 wage-earners; their total remuneration was $4,034,075. Fuel cost $1,909,591, including $218,166 paid for electric power. Total primary power employed was reported at 124 units with a manufacturers' rating of 8,356 h.p. Electric motors to a total of 340 units were in use during the year. The amount of China Clay imported in 1925 amounted to 363,890 cwt., valued at $195,032.

China Clay Interests Kill £15,000 Scheme

It is generally considered that the St. Austell Isolation Hospital Board have acted wisely in taking the two local governing bodies into their confidence over the question of an isolation hospital, and will have the support of the ratepayers in their decision to defer the erection even of a £6,000 institution for at least 12 months. Thanks to the opposition raised by the China Clay producers and other large ratepayers when the original £15,000 scheme was contemplated, the ratepayers have been saved a good sum of money. Though the £6,000 scheme would not involve such a big annual outlay in loan charges and upkeep, it is big enough to avoid in these times of financial stress. There are many ratepayers who are strongly of the opinion that the setting up of even such a modified hospital as that now contemplated is not necessary in a rural area like St. Austell, where the number of cases of infectious diseases requiring isolation are few and far between. Nothing could have stopped the Board going right ahead with their £6,000 scheme, but recognising that those who pay the piper should call the tune, they have sought the sanction of the two councils for their decision to hold up the scheme for another year. There is no difficulty in getting the two councils to agree to that, but it is hoped that even then the councils will be again consulted before the scheme is started. With the whole area now covered with a network of water and sewerage schemes, and the vast improvement in the sanitation of the district that has resulted, there are many students of hygiene who question the necessity of an Isolation Hospital at all, and who consider that the next step to be taken should be the disbandment of the Board. In these times of stringency and rate burdens, this is an aspect of the case worth considering in the interests of the ratepayers, and which the China Clay interests in the district do not intend to lose sight of.

China Clay in Enamelling

One of the many good practices the enamelling industry has acquired from the older industry of the potter is the employment of China Clay. Enamels like glass comprise the fluxes potassium, sodium, and calcium oxides, and the refractories alumina and silica. Silica comprises about 50 per cent. of the final enamel and is the main ingredient producing hardness in the burning process. Alumina introduces many desirable properties. In addition to producing hardness, it helps the enamel to adhere to the iron base, slows down the rate of cooling after fusing, thus preventing cracks and chips, and being capable of acting chemically both as an acidic or basic oxide, acts as a go-between for the fluxes and refractories. Alumina and silica are mainly introduced into the enamel in the form of felspar—potassium aluminium silicate—and any more alumina necessary is obtained from cryolite—sodium aluminium fluoride. Both of these compounds contain fluxes, however, and when these are not required China Clay is a preferable source of alumina and silica.

The chief use of clay in enamelling is for suspending in the slop state, and for this purpose the more plastic Ball Clays are used, but ignited China Clay may be added on grinding for the sole purpose of raising the fusing point. It is generally introduced, however, before fritting. A white burning clay is a necessity, and success depends upon it being in a fine state of division, otherwise it will float on the batch in the melting furnace, ball together, and become infusible. The usual treatment, therefore, is to dry it thoroughly and crush it to pass at least a 20-mesh sieve. The impurities looked for are principally carbonates and excess quartz, whilst the water contained is an important factor—none of these is injurious, but in appreciable proportions would upset the batch mixture. Since the average cost of material comprising the enamel batch runs from about 1·5d. to 2d. per lb., and as China Clay can be obtained at about 1s. 3d. per lb. it is economical to use. Many enamellers do so, but the field is by no means fully explored.

Some Characteristics of Clay

Divergence of opinion exists with regard to the composition of the material from which clays derive their peculiar characteristics. It is claimed that numerous clays are the result of centuries of grinding, forming a film of colloidal matter (composed principally of alumino-silicic acids) on grains of non-plastic material. Doubtless other opinions apply in particular instances. It has been repeatedly demonstrated that colloidal matte is present in clay, and that both possess a number of properties which are intimately associated. Numerous qualities of clay are similar in character to colloidal gels. Analysts have succeeded in separating the colloidal matter called "ultra clay." When moist, this ultra clay is particularly plastic and excessively sticky; when dry its adhesive strength is greater than cement, but on the addition of moisture the adhesive strength speedily diminishes. In soils, ultra clay is the principal binding material, hence its importance in fundamental work.

A colloidal solution is formed by a liquid medium having in it fine particles of clay and silicic acid in colloidal form measuring from those of microscopic to molecular dimensions. The natural aptitude of clay to settle by gravitation is overcome by some opposing force which contributes to maintain small masses in suspension for an indefinite period, and, at the same time, in a condition of constant motion. Clay particles in suspension unite and coagulate when such material as alum is added to the liquid. With the stoppage of motion, precipitation occurs. Some of the particles are so minute that they are capable of passing through the pores of common filter paper. Clay particles are also capable of conveying electrical charges and consequently act as ions. Certain colloids possess the power of absorbing other colloids and also fine particles of bacteria, clay, and colouring matter.

For the purpose of determining the size of pores in clay numerous mechanical analyses and microscopical examinations of individual particles have been made by various authorities with the following results: The relations between porosity and the percentage of voids in clay display considerable discrepancies; this disagreement is accentuated in accordance with any increase in the plasticity of the clay. The rate of movement of water through plastic clay is very slow. A study of the dimensions of passages between contiguous particles leads to the conclusion that the viscosity of the water increases rapidly as the openings, through which it flows, decrease. The presence of water with several times its normal viscosity is apparently an essential condition for the plasticity of clay.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—March, 1927

Arrived.	Name.	Sailed.	Destination.
March 1,	S.S. *Ravenspoint*	March 2,	Genoa
March 1,	M.V. *Annie*	March 7,	Salcombe
March 1,	S.S. *Gouwestroom*	March 3,	Amsterdam
March 1,	S.S. *Blush Rose*	March 5,	Preston
March 2,	S.S. *Carronpark*	March 8,	Portland, Me.
March 3,	S.S. *Magrix*	March 4,	Hull
March 3,	M.V. *Eurasia*	March 12,	Antwerp
March 5,	S.S. *Baron Ailsa*	March 10,	Portland, Me.
March 6,	S.S. *Delphinus*	March 9,	Skien
March 7,	S.S. *Farfield*	March 8,	Par
March 7,	S.S. *Pansy*	March 12,	Weston Pt.
March 7,	S.S. *Lesrix*	March 10,	Antwerp
March 9,	S.S. *Horn*	March 11,	La Palice
March 9,	S.S. *Harlaw Plain*	March 10,	Weston Pt.
March 9,	S.S. *Fellside*	March 12,	Brussels
March 9,	M.V. *August Schierloh*	March 11,	Hamburg
March 9,	S.S. *Farfield*	March 12,	Antwerp
March 10,	S.S. *Dorset Coast*	March 12,	Liverpool
March 10,	S.S. *Ardri*	March 15,	Leith
March 11,	S.S. *Nadja*	March 12,	Bo'ness
March 11,	S.S. *Birmingham*	March 17,	Liverpool
March 11,	M.V. *Donald & Doris*	March 18,	Rochester
March 12,	S.S. *Mourne*	March 15,	Bristol
March 12,	M.V. *Wilhelm Luhring*	March 17,	Charlestown
March 12,	S.S. *Brier Rose*	March 15,	Manchester
March 12,	S.S. *Tynebridge*	March 18,	New York
March 12,	M.V. *Mayblossom*	March 15,	Plymouth
March 13,	S.S. *Blush Rose*	March 16,	Runcorn
March 13,	S.S. *Hayle*	March 18,	Garston
March 13,	S.S. *Enid Mary*	March 19,	Antwerp
March 13,	M.V. *Johanna*	March 18,	Bremen
March 14,	S.S. *Ciscar*	March 15,	Genoa
March 14,	S.S. *Annchen Peters*	March 17,	Harburg
March 14,	M.V. *Anna Kirstine*	March 18,	Rudjkoping
March 14,	M.V. *Ianthe*	March 18,	Gravelines
March 15,	S.S. *Quaysider*	March 18,	Brussels
March 15	S.V. *La Revanche*	March 17,	Charlestown
March 15,	S.S. *Porthleven*	March 17,	Par
March 16,	M.V. *Asta*	March 18,	Granton
March 16,	S.S. *Glenbrook*	March 19,	Gravelines
March 16,	S.S. *Haardraade*	March 23,	Brussels
March 16,	S.S. *Gower Coast*	March 19,	Liverpool
March 17,	S.S. *Zaanstroom*	March 22,	Amsterdam
March 18,	S.S. *Horn*	March 22,	Pasages
March 18,	S.S. *Guelder Rose*	March 23,	Weston Pt.
March 18,	S.S. *Mersey*	March 19,	Preston
March 20,	S.S. *Primrose*	March 24,	Antwerp
March 20,	S.S. *Baron Garioch*	March 25,	Portland, Me.
March 20,	M.V. *Kurt*	March 24,	Hamburg
March 20,	S.S. *Holmewood*	March 24,	Baltimore
March 20,	S.V. *Alice Williams*	March 19,	Par
March 20,	S.V. *W. E. Gladstone*	March 28,	Plymouth
March 21,	S.V. *Paix*	April 4,	Dunkirk
March 21,	S.S. *Brier Rose*	March 28,	Runcorn
March 23,	S.S. *Letty*	March 26,	Gravesend
March 23,	S.S. *Southwell*	March 26,	Rouen
March 23,	S.S. *Ortona*	March 26,	Antwerp
March 23,	S.S. *Miriam Thomas*	March 25,	Preston
March 23,	S.S. *Christina*	March 26,	Antwerp
March 23,	S.S. *Mourne*	March 25,	Runcorn
March 23,	S.S. *Smaragd*	March 24,	Par
March 23,	S.S. *Foy*	March 26,	Gravesend
March 24,	S.S. *Leaside*	March 29,	Antwerp
March 24,	S.S. *Jolly Angela*	March 28,	Ridham
March 25,	S.S. *Edenside*	March 29,	Par
March 25,	S.S. *Freighter*	March 26,	Par
March 25,	S.S. *Stock Force*	March 30,	Runcorn
March 25,	S.S. *Magrix*	March 29,	Gravesend
March 26,	S.S. *Agdir*	March 29,	Antwerp
March 27,	S.V. *Raymond*	*	
March 27,	M.V. *Isabel*	*	
March 28,	S.S. *Florentino*	March 29,	Genoa
March 28,	S.S. *Rossmore*	March 30,	Bo'ness
March 28,	S.S. *Aspholm*	April 1,	Christiansand
March 28,	M.V. *Romanie*	April 1,	Gijon
March 28,	M.V. *Theodora*	March 28,	Mevagissey
March 29,	S.S. *Wheatsheaf*	April 1,	Preston
March 29,	S.V. *Francis & Jane*	April 1,	Charlestown
March 30,	S.S. *Farfield*	April 1,	Grimsby
March 30,	S.V. *Rose*	March 31,	Charlestown
March 30,	S.S. *Pansy*	April 2,	Ridham
March 30,	S.S. *Pylades*	March 31,	Methil
March 30,	S.S. *Gower Coast*	April 2,	Birkenhead
March 30,	S.S. *Dorset Coast*	April 2,	Birkenhead
March 30,	S.S. *Wheatlands*	April 2,	Preston
March 31,	M.V. *Eurasia*	April 1,	Fremington

* In port.

Charlestown Shipping—March, 1927

Arrivals

Date.	Vessel.	From
March 3,	*Jane Banks*	Falmouth
March 5, S.S.	*Glenrose*	Kingsbridge
March 8, S.S.	*Goole*	Truro
March 8, S.S.	*T. W. Stewart*	Truro
March 8, S.S.	*Cromarty Firth*	Dartmouth
March 10,	*Wellington*	Fowey
March 12, M.V.	*Wilhelm Luhring*	Methil
March 14, M.V.	*Nordstern*	Poole
March 17, S.S.	*Condor*	Torquay
March 17,	*J. Milton*	Mevagissey
March 17,	*La Revanche*	Fowey
March 18,	*Lady Rosebery*	Truro
March 18, S.S.	*Norrix*	Exmouth
March 18,	*Mary Miller*	Newport
March 20, S.S.	*Beeston*	Waterford
March 22, S.S.	*Coniscrag*	Plymouth
March 24, S.S.	*Agdir*	Topsham
March 24, S.S.	*Eastoft*	Dartmouth
March 28,	*Lady Jean*	Truro

Sailings

Date.	Vessel.	Destination.
March 1,	*Lady Agnes*	London
March 5,	*Jane Banks*	Aberdeen
March 7, S.S.	*Glenrose*	Sunderland
March 9, S.S.	*Cromarty Firth*	Leith
March 10, S.S.	*Goole*	Rochester
March 10, S.S.	*T. W. Stewart*	Rochester
March 11,	*Wellington*	Goole
March 15, M.V.	*Nordstern*	Hamburg
March 18, S.S.	*Condor*	Antwerp
March 19,	*J. Milton*	London
March 19, S.S.	*Norrix*	London
March 22,	*Lady Rosebery*	Snodland
March 23, M.V.	*Wilhelm Luhring*	Rochester
March 23, S.S.	*Beeston*	Aberdeen
March 23,	*La Revanche*	Nance
March 23, S.S.	*Coniscrag*	Gravesend
March 25, S.S.	*Agdir*	Antwerp
March 25, S.S.	*Eastoft*	Gravesend
March 28,	*Mary Miller*	Rochester
March 29,	*Lady Jean*	Snodland

Penzance Shipping—March, 1927

Arrived.		Sailed.	Destination.
March 2,	S.S. *Westdale*, of Liverpool	March 5,	Northfleet
March 11,	M.V. *Grit*, of London	March 17,	Purfleet
March 10,	M.V. *Steiermack*, of Germany	March 24,	Hamburg
March 28,	S.S. *Gylfe*, of Gothenburg	April 1,	Baltic

Par Harbour Shipping—March, 1927

Arrivals

Date.	Vessel.	From
March 2, S.S.	*Grovehill*	Plymouth
March 2, S.S.	*Isabeletta*	Guernsey
March 3, S.S.	*Mondara*	Charlestown
March 5, S.S.	*Balmyle*	St. Briex
March 7, S.S.	*Farfield*	Fowey
March 10, M.V.	*Capable*	Chichester
March 10, M.V.	*Iron King*	Plymouth
March 12, S.V.	*Georges Raymonde*	Dieppe
March 13, S.S.	*Treleigh*	Portreath
March 14, M.V.	*St. Austell*	Cowes
March 15, S.S.	*Wheatplain*	Plymouth
March 17, S.S.	*Porthleven*	Fowey
March 18, S.V.	*Alice Williams*	Fowey
March 20, S.S.	*Porthleven*	Pentewan
March 22, S.S.	*T. W. Stuart*	Totnes

March 23, S.S. *Smaragd* ..... Exmouth
March 26, S.S. *Freighter* ..... Blyth
March 28, M.V. *Capable* ..... Torquay
March 28, S.V. *Hero* ..... Falmouth
March 29, M.V. *Lee Lee* ..... Antwerp
March 29, S.V. *Rose* ..... Dartmouth
March 30, S.S. *Edenside* ..... Fowey

Sailings

Date.	Vessel.	Destination.
March 1, S.S.	*Robrix*	Gravesend
March 4, S.S.	*Grovehill*	Preston
March 5, S.S.	*Isabeletta*	Weston Point
March 5, S.S.	*Mondara*	Larne
March 6, S.V.	*Englishman*	Runcorn
March 6, S.V.	*Brooklands*	Gloucester
March 7, S.V.	*Flying Foam*	London
March 7, S.S.	*Balmyle*	Glasgow
March 9, S.S.	*Farfield*	Fowey
March 13, M.V.	*Iron King*	Plymouth
March 14, M.V.	*Capable*	Rochester
March 17, S.S.	*Treleigh*	Preston
March 17, S.S.	*Porthleven*	Pentewan
March 18, M.V.	*St. Austell*	Plymouth
March 18, S.S.	*Wheatplain*	Larne
March 22, S.S.	*Porthleven*	Preston
March 24, S.S.	*T. W. Stuart*	Gravesend
March 27, S.V.	*Georges Raymonde*	Paimpol
March 30, S.S.	*Freighter*	Pentewan
March 30, M.V.	*Capable*	Rochester

Par Harbour Tide Table, May, 1927

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Sunday	1	5.55	6.18	14.1
Monday	2	6.41	7.4	14.3
Tuesday	3	7.26	7.47	14.2
Wednesday	4	8.8	8.29	13.7
Thursday	5	8.50	9.11	12.9
Friday	6	9.31	9.52	11.8
Saturday	7	10.14	10.39	10.8
Sunday	8	11.7	11.39	9.10
Monday	9	—	0.16	9.4
Tuesday	10	0.56	1.36	9.5
Wednesday	11	2.14	2.49	10.0
Thursday	12	3.21	3.50	10.8
Friday	13	4.16	4.38	11.4
Saturday	14	4.58	5.17	11.11
Sunday	15	5.35	5.52	12.3
Monday	16	6.9	6.26	12.5
Tuesday	17	6.44	7.1	12.6
Wednesday	18	7.17	7.33	12.6
Thursday	19	7.50	8.7	12.4
Friday	20	8.24	8.42	12.0
Saturday	21	9.1	9.21	11.6
Sunday	22	9.42	10.5	11.0
Monday	23	10.31	11.0	10.6
Tuesday	24	11.33	—	10.2
Wednesday	25	0.9	0.48	10.3
Thursday	26	1.29	2.8	10.11
Friday	27	2.43	3.15	11.9
Saturday	28	3.44	4.12	12.7
Sunday	29	4.39	5.5	13.2
Monday	30	5.30	5.56	13.6
Tuesday	31	6.21	6.45	13.6

E. CLEMENS, Harbour Master.

China Clay Imports for March, 1927

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of March, 1927, indicates that 100 tons, value £140, were imported from Belgium, and 9 tons, value £14, from Greece; the total being 109 tons, value £154.

March Deliveries

Quarter's Total Nearly 20,000 Tons below 1926

THE expected spurt in turnover for March was not realised, the aggregate total of business done having been 345 tons below that in the shorter month of February. Taking the figures separately, China Clay deliveries were 538 tons better, and China Stone deliveries 1,116 tons better, but there was a drop of 2,008 tons in deliveries of Ball Clay. Compared with March last year, this year's figures showed decreases in every section :—China Clay, 8,539 tons; China Stone, 184; Ball Clay, 669. The total difference on the aggregate was 9,392 tons. On the three months this year compared with the corresponding three months last year, the total tonnage is down by 19,294 tons, China Clay being responsible for a decrease of 20,359, Ball Clay for a decrease of 251 tons. In the China Stone section there was an increase of 1,316 tons. The details of this year's tonnage compared with last year's are as follows :—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total. Tons.	
Port.	1927.	1926.	1927.	1926.	1927.	1926.	1927.	1926.
Fowey	53,552	63,573	4,546	4,983	555	1,224	58,653	69,780
Charlestown	4,909	4,167	—	—	—	—	4,909	4,167
Par	3,308	3,159	603	350	—	—	3,911	3,509
Plymouth	1,889	2,674	—	—	—	—	1,889	2,674
Penzance	1,612	335	—	—	—	—	1,612	335
Falmouth	260	183	—	—	—	—	260	183
Newham	—	158	—	—	—	—	—	158
By Rail	5,324	4,744	—	—	—	—	5,324	4,744
March	70,854	79,393	5,149	5,333	555	1,224	76,558	85,950
February	70,316	81,338	4,033	3,166	2,563	1,558	76,912	86,055
January	65,955	66,760	4,375	3,742	2,569	3,136	72,899	73,638
Three months	207,125	227,484	13,557	12,241	5,687	5,938	226,369	245,663

China Clay Exports for March, 1927

A RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination as registered during the month ended March 31, 1927 :—

Country of Destination.	China Clay Quantity Tons.	Value £
Finland	400	485
Estonia	679	677
Sweden	594	1,717
Norway	2,188	2,964
Denmark	8	36
Germany	3,905	8,902
Netherlands	3,523	7,661
Belgium	6,892	11,969
France	1,981	2,882
Portugal	20	80
Spain	1,098	2,627
Italy	2,435	6,131
Egypt	15	28
China	18	91
Japan	53	340
United States of America	21,038	43,878
Mexico	80	346
Colombia	1	12
Chile	5	18
Brazil	15	40
Bombay, via Other Ports	1,330	5,074
Bengal	149	521
Australia	38	320
New Zealand	1	9
Canada	2	7
Irish Free State	11	31
Total	46,479	96,846

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

BLABY BRICK AND TILE CO., LTD. Registered March 10. £2,500 (not ex.) charge, to Bank; charged on lands at Glen Parva.

STENALESS CHINA CLAY CO., LTD., St. Austell. Registered March 7, £1,000 debs.; general charge.

Satisfactions

BARNES AND SEAGER, LTD., Portsmouth, paper manufacturers. Satisfaction registered March 7, £2,000, registered October 7, 1925.

MEAKIN (J. AND G.), LTD., Hanley, earthenware manufacturers. Satisfaction registered March 10, £1,500, part of amount registered May 3, 1909.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

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The Trade Outlook

As with so many other industrial undertakings that have issued their reports for last year, English China Clays, Ltd., the biggest individual concern engaged in the China Clay industry, has to record a serious falling-off of profits owing to the drain made upon its resources by the general and coal strikes. Though the inroads made upon the industry have been serious, so far as English China Clays, Ltd., is concerned they are not irreparable nor so deep as might have been expected, when it is borne in mind to what an abnormal figure the price of coal rose and how working costs were increased.

English China Clays Experience

The remarks of the chairman (Mr. Reginald Martin) at the annual meeting of the company make interesting reading, and while directed more particularly to showing the experience of his own firm, may be taken in many respects to illustrate the experience and outlook of the trade as a whole. It is interesting to note, as an instance of commercial probity, that the company honoured their contracts as regards price in the letter as well as in the spirit, a thing they were not bound to do in view of the saving clauses in contracts relating to interruption of trade by strikes. It must, therefore, be counted for righteousness to English China Clays, Ltd., and other firms who acted similarly, that they did not pass on the burden to the consumer, but bore it themselves. Consumers, therefore, ought not to cavil at the increases in prices of certain grades of clay that came into operation at the beginning of this year.

Effect of Duty on Translucent Pottery

As producers of the chief raw materials required by the pottery trade, the China Clay industry is hoping that the import duty on translucent pottery may give a much-needed fillip to the home pottery industry. As the translucent pottery makers of other countries mainly use their own domestic clays for this class of ware, and import very little English China Clay and China Stone for the purpose, the China Clay industry will clearly be the gainer by any considerable increase in production of translucent pottery at home.

Cotton Trade Demand

With the protracted disturbances to trade in China and their adverse influence upon production in the Lancashire cotton mills, the prospects are not promising for any enhanced demand for China Clay in this quarter, but a growing demand for the supply of cotton mills in India may counteract the effect of the Chinese upheaval on Lancashire business.

Competition in Best-Clays Markets

The absorption by English China Clays, Ltd., of the North Goonbarrow China Clay Co.'s production and selling business restricts still further the number of individual firms producing best clays. North Goonbarrow has long had the reputation of producing one of the highest-grade clays on the market, for which there has always been a big demand at a very high price. English China Clays, Ltd., have, therefore, done a good stroke of business in carrying through the deal, and thus adding to their already big range of best clays. The "deal" means more than appears on the surface, for it still further limits the scope of supplies of best clays available for purchase by American middlemen buyers who supply consumers in the States, where English China Clays, Ltd., have their own direct-to-consumer service through the China Clay Sales Corporation centred in New York. We understand that this new coup of English China Clays, Ltd., has caused something of a flutter in the dovecotes of the American middlemen buyers of our home-produced China Clays, it being of best imported clays that American consumers stand most in need, because, while there is an abundance of common white clays in America, deposits of best clays of the character of our best English clays are few and far between.

The Position of American Middlemen

There is something of a tussle going on in the States over the capture of the best clays market in America, and the parties who possess or can supply it are the most likely to extend their business in this branch. If the American middleman merchant cannot, through restricted supplies on this side, adequately supply that market, he may be driven to leave it to such direct-from-producer-to-consumer producers as English China Clays, Ltd., or seek to get his customers interested in domestic produced clays of inferior qualities. What the upshot of the contest will be remains to be seen, but let us hope it will not be to the eventual detriment of the home China Clay industry.

The development of markets for our China Clays in the States has been due to a large extent to their cultivation by American middlemen who have pushed the imported article with great persistence in the face of the much "boosted" but much less favoured domestic article. This being the case it is undesirable that anything in the nature of antagonism should arise between our producer merchants and American middlemen-merchants, such as would force the latter to transfer their allegiance from our home-produced clays to those produced in America. It should be possible for some basis of accommodation to be found so that the valuable connections held by American middlemen shall not be lost to our home trade through any feeling of pique, however unwarranted or unjustified that may be, provoked by the idea that they are not getting or may not get a "square deal."

A China Clay View of the Budget

Giving his opinions upon the Budget, Mr. W. H. Whiteway-Wilkinson, of Whiteway and Co., China Clay merchants and shippers, Newton Abbot, said: "The Budget does not give much encouragement to the supporters of any political party in regard to economy. The present indications, and also the appearance of the future, show that we are going back to pre-war competition. Other countries are competing with us, and we are still being saddled increasingly instead of decreasingly with the burdens of taxation, which does not put us in any more favourable position to meet the situation. On the contrary, this is going from bad to worse. The terrible part of the thing is the complete supineness in visualising the extreme gravity of the position from a trade point of view."

1926 Strike Sequel

Report of English China Clays, Ltd.

THE unsettling effects of last year's strike on the China Clay industry is emphasised by the balance sheet of English China Clays, Ltd., the biggest firm engaged in the China Clay industry, showing a drop in the net profits of over £25,000—from £83,018 in 1925 to £57,621 in 1926.

The directors in their report state : " The direct and indirect effects of the general strike and the coal strike are the main causes of the decline in profits, and the effect will be felt in the early part of this year. The directors express regret that the negotiations for the formation of another association failed." The following reference is made to the amalgamation of the interests of the North Goonbarrow China Clay Co., Ltd. " The company has since December 31, 1926, acquired the whole of the shares of the North Goonbarrow China Clay Co., Ltd. In pursuance of the contract under which those shares were acquired, Mr. Hart Nicholls has been appointed a director of the company."

Distribution of Profits

In reference to the utilisation of the profits of the company, a final dividend of one per cent. is declared on the ordinary shares, making 3 per cent. for the year, absorbing a total of £38,070. The payment of 7 per cent. dividend on the preference shares for the year absorbed £21,333 3s. 8d. These dividends account for a total of £59,403 3s. 8d. The net profits on the year, £57,621 12s. 4d., plus £11,175 18s. 2d. brought forward from the preceding year, made available for distribution £68,797 10s. 6d., so that after meeting the amounts required for dividends for the year there is a balance to carry forward of £9,394 6s. 10d.

The balance sheet shows that of the authorised capital of the company (£2,000,000), 307,186 of the 400,000 seven per cent. £1 cumulative preference shares have been issued and 1,269,000 of the 1,600,000 £1 ordinary shares—total 1,576,186. The general reserve was increased £25,000 to £30,000. Investments stood at the end of the year at £91,655 11s., against £111,921 3s. 6d. in 1925, and cash at bank and in hand at £21,049 12s. 11d., against £55,397 18s. 9d.

The Annual Meeting

At the annual meeting on Tuesday, April 26, presided over by Mr. Reginald Martin (chairman and managing director), the chairman, in moving the adoption of the report and accounts, recalled his view a year ago, when he had ventured the opinion that the prospects for 1926 appeared to be encouraging, provided nothing unforeseen occurred to upset the trade generally. Within a very few days that precaution had unfortunately been fully justified, as the general strike and miners' strike effectively checked the trade improvement that was undoubtedly making itself apparent, and their company had suffered in common with the rest of the trading community. Excessively high prices, combined with low efficiency of fuel, had made a very serious increase in cost of production, no part of which they had been able to recoup, because, being under contracts which extended to the end of the year for the sale of the company's products, the board had felt in honour bound to fulfil them. Another contributory cause of the decrease in profits had been the failure of the negotiations for the formation of an association of China Clay producers, followed by a further drop in the prices of the lower-grade clays.

In such adverse circumstances the Board were agreeably surprised at being able to submit so satisfactory a result of the year's working. (Hear, hear.)

As regards shipments, 1926 must be looked on as a remarkable post-war year in the China Clay trade, taking the abnormal industrial conditions into consideration. The total for the trade had been 870,000 tons, or only about 60,000 tons less than 1925. Satisfactory expansion had taken place in exports to America, India, Germany, the Netherlands, Belgium, Finland, and Sweden, and the home market had absorbed more than could have been reasonably expected. Consumption in France, Italy, and Spain showed a slight reduction. Improvements and extensions had been made at the various works of the company during the year, and within a short time practically the whole of the uneconomical plant would have been eliminated and the works equipped with up-to-date machinery. The fire which occurred early in October at the head office had fortunately not been attended with serious consequences, and the damage had been fully recovered by insurance.

North Goonbarrow Deal

A matter of particular interest referred to in the report was the acquisition of the whole of the shares of the North Goonbarrow China Clay Co., Ltd. The deal had been effected on a mutually satisfactory basis, and the directors were satisfied that it would prove a great asset to the company. Not only was the property one of first-class importance, equipped with modern plant, capable of producing a large quantity of highest-grade clay at low cost, and possessing large reserves, but, owing to the close proximity of the work to the Great Beam and Goonbarrow pits belonging to English China Clays, it offered possibilities of effecting considerable economies on the working of those two properties. Mr. Hart Nicholls, who had been sole managing director of the North Goonbarrow China Clay Co., Ltd., had consented to join the Board of English China Clays, so that the company would have the benefit of his lifelong experience.

Without being over-optimistic he thought he could predict that 1927 would prove to be a more prosperous year to the company than its predecessor. The import duty on translucent pottery should give a much-needed fillip to the home pottery trade, and though Lancashire was suffering at the moment owing to the disturbances in China, as soon as the conditions in that country became more settled, the staple trade of the country would undoubtedly improve rapidly. The reduction in the Bank Rate would be of great assistance to trade generally.

Mr. T. Medland Stocker, J.P. (managing director), seconded the motion, which was carried unanimously.

National Association of Clayworks Managers

Lecture by Mr. A. B. Searle

AT a recent meeting of the Sheffield Branch of the National Association of Clayworks Managers, with Mr. Frank Russell in the chair, Mr. A. B. Searle, one of the vice-presidents of the Association, gave a short lecture on " Brick Earths " in which he described some of the remarkable properties of the materials used for brickmaking. He showed a sample of dried clay, which after it had been examined by all present and pronounced by some to be a good brick clay, he declared, had ruined more people than any other brick clay in the country ! He explained the reason for some of its unexpected properties and the difficulties experienced in working it, and passed on to a description of other troublesome brick-earths and other kinds of clays. He astonished some of the members by declaring that it is almost impossible to define the meaning of the word clay satisfactorily, and described a material which was highly plastic when wet, shrank when dried and had almost all of the recognised properties of clay yet was of an entirely different chemical composition. This, he suggested, was only one of the difficulties experienced in trying to investigate the true nature of clay.

After describing some of the difficulties in interpreting analyses of clay and stressing the importance of other tests before reaching definite conclusions, the lecturer explained some of the troubles caused by impurities in the clay, and dealt especially with " black cores," " carbonaceous matter," " shale oil " and " scum," but left the subject of " lime " to a future occasion. He also dealt briefly with the subject of excessive shrinkage. " The reason the fundamental nature of clay is not better understood," he said, " is to be found in the nature of the material itself. It is not due to lack of attention on the part of scientists or of practical men, but to the inherent difficulties in the work of investigation. Similarly with plasticity, which varies so much from one clay to another and is so greatly affected by apparently trifling changes in the proportion of some ingredients. It is, of course, the fascination of the subject which makes these unexpected changes so interesting, which stirs up all managers and other clayworkers to do their best with the material, which keeps everyone who has to work with clay in a state of wonder as to what will happen next and, in short, makes brick-earth one of the most interesting materials in the wide, wide world." After the lecture there was an animated discussion which lasted almost as long as the lecture itself. In it many practical questions were raised and answered in various ways, and all present agreed that no technical meeting could have been more enjoyable, more instructive, or more practically useful.

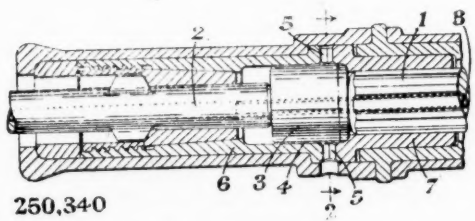
Recent Patent Specifications Accepted

Rock Drills and Ropeways

The following are abstracts of recently accepted specifications of new patents of machinery of particular interest to the China Clay and China Stone industries.

Rock Drills

250,340. Rock Drills. J. L. Holman, "Veor," Camborne, Cornwall, and A. T. Holman, "Tregenna," Camborne, Cornwall.—The forward fluted end of a piston hammer is indicated at 1, and between it and the drill bit 2 is an anvil block 3, which is formed with a flat 4 along its lateral face. This flat affords a passage communication with both end faces of the anvil block—that is to say, it affords a passage between the forward end of the hammer cylinder (through the medium of the flutes in the portion 1 of the hammer piston) and the space in the drill chuck forward of the anvil 3. Exhaust ports 5 are formed, partly in each of two parts of a dog or like clutch, comprising a driving connection between a sleeve clutch 6 in which the anvil block 3 slides and a turning member 7 therefor, which member is a sleeve rotated in a well-known manner through part 1, and a ratchet mechanism operated during the oscillatory movements of the hammer piston.

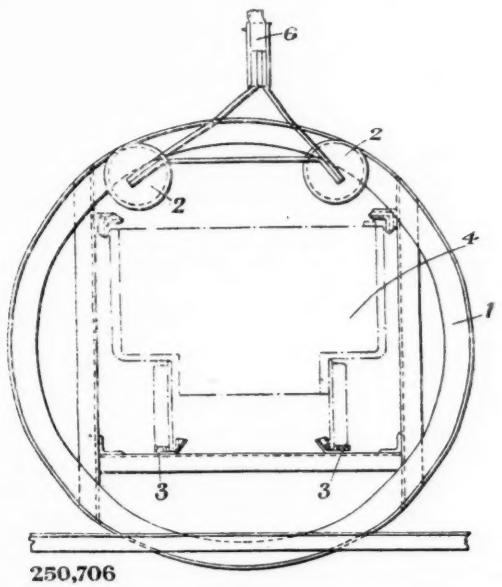


250,340

The anvil block 3 has a central bore, through which passes the water-tube 8, and there is a good sliding fit between these two parts and also between the anvil block and the chuck sleeve 6, except for the flat 4. It is found that, in normal operation, such motive fluid as passes the fluted portion 1 of the hammer piston will have free access to the exhaust ports 5, as this passage of motive occurs mainly at the time that the anvil block 3 has been moved forwardly by the impact of the hammer. Such tendency as exists for the motive fluid to leak past the anvil block through the passage afforded by the flat 4, without escaping through the ports 5, is small, and the quantity thus leaking past is insufficient to cause any material difficulty with the production of the fine dust which is formed. The passage afforded by the flat 4, however, has an advantage in that any water which may accumulate in the chamber surrounding the end of the drill bit and forward of the anvil block 3 can readily escape through the passage and through the exhaust ports 5. (Seven claims.)

Aerial Ropeways

250,706. Aerial Ropeways. G. A. Main, 47, Victoria Street, Westminster, London, S.W.1.—The two circular frames 1, 1 are carried by wheels 2, 2 and support rails 3, 3 upon which the tub or wagon 4 is run directly into the tippler and securely locked by any suitable means. The wheels 2, 2 are suspended from a ropeway, preferably through the intermediary of a beam 6, which is provided at one end with a bracket supporting a pivoted catch adapted to engage in a slot in a flange 10 extending inwardly of one of the circular frames 1. The tub is held so that its centre of gravity when loaded is sufficiently offset from the point of suspension of the circular frames to ensure that the tub will be automatically tipped under gravity when the said catch 8 is released from its slot. For operating the catch is employed a half-nut 11 engaged by a screwed rod 12 driven by a flexible shaft from one of the wheels of the conveyor. Rotation of the rod moves the half-nut up against a tail 8*a* of the catch 8 and releases it from the slot at the appropriate time. When the tippler is inverted a lug mounted on one of the circular frames engages one arm of a lever which rotates the square shaft 18 upon which the said lever is slidably mounted so as to lift the half-nut out of engagement with the spindle, the half-nut being carried by the other arm of the lever. With the shaft also rotates a pawl-controlled ratchet so as to hold the half-nut out of engagement with the screwed rod, whereupon the half-nut runs along the square shaft by gravity. The lever is preferably mounted on the square shaft by means of four rollers, to facilitate its movement along the shaft. When the conveyor reaches the loading point, a fixed lug engages a tail of the



250,706

aforementioned pawl so that the latter is lifted from the ratchet, and the lever which effects the lifting of the half-nut returns to its former position under force of gravity or the influence of a spring or weight. By providing an adjustable stop in connection with the retractive movement of the half-nut, the point along the ropeway at which the catch is released from the slot, which is dependent upon the length of the screwed rod requiring to be traversed by the half-nut, can be accurately determined. (Nine claims.)

New Civic Head of Clayopolis

Mr. F. W. Mutton, of the old-established China Clay cooperage firm of John Knight and Co., St. Austell, has just been elected chairman of the St. Austell Urban Council, which makes him the civic head of the town and a magistrate. Mr. Mutton is the third son of the late Captain W. Mutton, who was for a great number of years manager of John Lovering and Co.'s China Clay shipping and dries at Charlestown. Mr. Mutton was one of the new members elected to the greater St. Austell Urban Council two years ago, following the extension of the area, and some years ago sat as a representative for Charlestown on the St. Austell Rural Council. His father-in-law was the late Mr. John Knight, of Charlestown, who established the cooperage business which still bears his name and of which Mr. Mutton is the chief proprietor. The works of the firm, which have been modernised by Mr. Mutton, are at Holmbush, where casks are made for both the China Clay and fish trade. Mr. Mutton has had experience of local government work, and is likely to prove a worthy successor to Mr. T. H. Williams, who has retired from the chairmanship after four strenuous years.

China Clay Notes and News

China Clay Road "Literally Impassable"

At the Highways Committee of the County Council, the surveyor said the Par Moor Road, which had not been surfaced since 1920, was, he had no hesitation in saying, the worst piece of road in the county, and had deteriorated to such an extent as to become literally impassable. The road is adjacent to Par Harbour and is much used by China Clay traffic from dries abutting it. Those having to use this road thoroughly endorse the surveyor's opinion regarding its condition, and the need for repair.

Fowey Dredger for Ireland

Fowey Harbour Commissioners have obtained recently a contract under the Great Southern Railway to dredge and restore the depth in Rosslare Harbour. The dredger, three barges, and a tug from Fowey will be used for the operations. The work will occupy several months. The dredger, which bears the typically Cornish name of *Tregeagle*, has done great service in the Fowey Estuary by deepening the fairway, as a result of which big ocean-going China Clay carrying steamers can enter and leave the port at all states of the tide.

China Clay Direct to India

The British steamer *Elmbank* recently loaded at Fowey a cargo of 7,000 tons of China Clay in bulk for Bombay. The agents of the steamer at Fowey are Hannan Samuel and Co., and the suppliers are English China Clays, Ltd. This cargo inaugurates a new service, being the first cargo of China Clay shipped from Fowey direct to India. Previous consignments for India have always been shipped in casks in smaller quantities from Fowey to Liverpool, Antwerp, and other ports, whence it has been shipped to Calcutta, Bombay, Madras, and other Indian ports.

English China Clays, Ltd.'s Deal

An important amalgamation has taken place between English China Clays, Ltd., and North Goonbarrow China Clay Co., Ltd. The latter firm has been associated, from its inception many years ago, with the name of Nicholls, who with the Stockers, Loverings, Dyers, and Martins, were among the pioneers of the China Clay industry. Mr. Hart Nicholls, the managing director, who with his brother, Mr. Tom Nicholls, has had the controlling interest in North Goonbarrow since his father and uncle died, has joined the board of English China Clays, Ltd. North Goonbarrow has been noted for the quality of its clays, which are amongst the best produced, so that English China Clays, Ltd., becomes possessed of a still further range of best clays by this amalgamation.

China Clay Wasted

The Highways Committee of the Cornwall County Council have considered the desirability of a by-law prohibiting the dropping of dirt on the highway. The surveyor said that the dropping of China Clay was costing hundreds of pounds a year in damage to the roads. There was a piece of road in Par which he went along three weeks after it was tarred, and, honestly, he could not see it had been tarred. The clay had perished the whole lot. It was perfectly ridiculous the way clay was thrown away. The chairman (Mr. J. C. Williams) said it could not be profitable to the China Clay people, and it was ruinous to their roads. Mr. Liddicoat protested against any industry which had enough to do to keep things going being harassed or hampered by such a by-law. The Committee decided to take no action.

Titanium in Clay

Titanium compounds occur in a large variety of substances, and are much more frequently present in clays, quartz, and felspar than is generally realised. The practice of including the amount of titanium with the alumina whilst recording analysis of clay, instead of stating the percentage of the metal present, does not encourage the better understanding of the subject. Titanium is one of the rarer metals, and is never found free in nature. It is of a greyish colour, resembling tin in its chemical properties, and, like that metal, is capable of forming two oxides, TiO and TiO_2, the latter being the only state in which it exists in nature.

According to Riley, titanium oxide occurs in almost all clays, generally in small proportions, but occasionally the percentages present are considerable. Experiments have proved that the proportion existing in kaolins does not appreciably affect their refractoriness. In different fireclays, however, the amount of the oxide present as a general rule runs from traces to 1·05 per cent.

Addition of Titanium

Rutile is the oxide of titanium used commercially. It possesses a metallic lustre and is either opaque or subtransparent, occurring in needle-like clusters radiately grouped in the interior of other minerals, especially in quartz. These crystals sometimes occur striated longitudinally, and also compact and massive, coloured either red-brown, red, yellowish, or black. Of adamantine quality, resembling tinstone in hardness, rutile possesses s.g. 4·2. It always contains from 1½ to 2½ per cent. of ferric oxide, and sometimes stannic and tungstic acids, a Swedish variety containing a small proportion of chromium. Formerly titanium oxide was considered of very little importance commercially, but in recent years, numerous investigations have led to its more general application. Divergence of opinion exists with regard to the advantage or otherwise of using clay with the addition of certain proportions of rutile. Claim is made that clays which require to be highly refractory should not contain more than 2 per cent. of the oxide. One authority maintains that any addition of rutile to fused silica accentuates its liability to devitrify. On the other hand, claim is made that provided the amount of the oxide added does not exceed 1 per cent., the tendency of the fused silica to devitrify is diminished, and its mechanical strength is increased. It is also rendered more capable of withstanding the influence of alkalis by the addition of 1 per cent. of rutile. Besides its usefulness in ceramics, rutile is added to clay, felspar, and flint in the manufacture of dental porcelain in order to impart a pinkish tint to artificial teeth. There are also now numerous titanium oxide paints on the market. In a recent patent, the paint containing the oxide is incorporated with a white mineral "extender" substance, such as China Clay, or whiting, the index of refraction of which is less than that of the oxide.

China Clay Exports for April, 1927

A return showing the exports of China Clay, the produce of the United Kingdom, from the United Kingdom to each country of destination as registered during the month ended April 30, 1927 :—

Country of Destination.	Quantity. Tons.	Value. £
Finland	10	35
Sweden	1,983	3,418
Norway	715	988
Denmark	660	860
Germany	3,322	7,846
Netherlands	3,947	8,067
Belgium	4,156	6,446
France	3,577	5,490
Spain	3,000	6,267
Italy	189	566
Greece	30	43
Roumania	23	50
China	4	16
United States of America	21,961	44,157
Mexico	70	298
Colombia	—	6
Brazil	20	100
Uruguay	30	88
Bolivia	—	1
Argentine Republic	20	120
Cape of Good Hope	—	6
Bombay, via Karachi	717	2,395
Bombay, via Other Ports	8,579	24,629
Madras	7	22
Bengal	335	1,063
Australia	27	195
Canada	80	421
Irish Free State	—	1
Total	53,471	113,603

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—April, 1927

Arrived.	Name.	Sailed.	Destination.
April 1, S.S.	*Blush Rose*	April 6,	Newport
April 1, S.S.	*St. Aidan*	April 3,	Charlestown
April 2, M.S.	*Cape of Good Hope*	April 9,	Portland, Me.
April 2, S.S.	*Adour*	April 8,	Pasages
April 2, S.S.	*Mercurius*	April 6,	Gothenburg
April 2, S.S.	*Blue Galleon*	April 7,	Northfleet
April 2, S.S.	*Inna*	April 7,	Antwerp
April 3, S.S.	*Arwyco*	April 12,	Runcorn
April 3, M.V.	*Prima*	April 9,	Oscarshamn
April 4, S.S.	*Brier Rose*	April 9,	Preston
April 4, S.S.	*Seatonia*	April 12,	Philadelphia
April 5, S.S.	*Knowl Grove*	April 8,	Hull
April 6, S.S.	*Zaanstroom*	April 13,	Amsterdam
April 6, S.S.	*Birmingham*	April 9,	Runcorn
April 6, M.V.	*Annemaria*	April 9,	Harburg
April 6, S.S.	*Grosvenor*	April 11,	Lancaster
April 7, S.S.	*Glenshesk*	April 13,	Weston Point
April 7, S.S.	*Horsham*	April 13,	Antwerp
April 7, S.S.	*Goole*	April 12,	Greenhithe
April 7, S.S.	*St. Aidan*	April 11,	Runcorn
April 7, S.S.	*Admiral*	April 9,	Liverpool
April 7, S.S.	*Elmpark*	April 20,	Bombay
April 8, M.S.	*Jantje Grünefeld*	April 13,	Antwerp
April 9, M.V.	*Lydia Cardell*	April 14,	Rouen
April 9, S.S.	*Miriam Thomas*	April 14,	Runcorn
April 9, S.S.	*Dorset Coast*	April 14,	Liverpool
April 10, M.V.	*Wilhelm Luhring*	April 14,	Harburg
April 10, S.S.	*Wheatplain*	April 14,	Antwerp
April 10, S.S.	*Pansy*	April 13,	Swansea
April 10, S.S.	*Horn*	April 14,	Bilbao
April 10, M.V.	*San Antonio*	April 18,	Mevagissey
April 10, M.V.	*Neptunus*	April 20,	Gefle
April 11, S.S.	*Marta*	April 20,	Gothenburg
April 11, S.S.	*Teesbridge*	April 22,	Philadelphia
April 11, S.V.	*Wellington*	April 28,	Charlestown
April 11, M.V.	*Mayblossom*	April 16,	Plymouth
April 11, M.V.	*Katie*	April 17,	Mevagissey
April 12, S.S.	*Hayle*	April 12,	Trevor
April 12, S.S.	*Hannah Holken*	April 20,	Harburg
April 13, S.S.	*Guelder Rose*	April 20,	Rouen
April 13, M.V.	*Eurasia*	April 20,	Plymouth
April 15, S.S.	*Mersey*	April 21,	Ridham
April 15, S.V.	*Waterwitch*	April 30,	Runcorn
April 16, S.S.	*Albert Jeffress*	April 27,	Philadelphia
April 16, S.S.	*Austin Gough*	April 21,	Southampton
April 16, M.S.	*Aarsten*	April 22,	Harburg
April 18, S.S.	*Masilia*	April 26,	Genoa
April 18, S.S.	*Baron Kelvin*	April 30,	Portland, Me.
April 20, S.S.	*Knowl Grove*	April 23,	London
April 20, S.S.	*Brier Rose*	April 23,	Preston
April 20, S.S.	*Crofter*	April 25,	Brussels
April 20, S.S.	*Pine*	April 23,	Weston Point
April 21, S.S.	*Ferndene*	April 26,	Antwerp
April 21, S.S.	*Rossmore*	April 27,	Bo'ness
April 21, S.S.	*Wans Fell*	April 26,	Antwerp
April 21, S.S.	*Cornish Merchant*	April 26,	Rouen
April 21, S.V.	*Mary Ann*	*	Runcorn
April 22, M.V.	*Mogens Koch*	April 27,	Karlskrona
April 22, S.S.	*Vera Kathleen*	May 2,	Portland, Me.
April 22, S.S.	*River Fisher*	April 27,	Preston
April 23, S.S.	*Glencregagh*	April 23,	Penarth
April 23, S.S.	*Mons*	April 29,	Antwerp
April 24, S.S.	*Huffnung*	April 29,	Hamburg
April 24, M.V.	*Kathe Jurgensen*	April 29,	Reval
April 24, S.S.	*Ryda! Force*	April 30,	Weston Point
April 24, S.S.	*Kilcloher*	*	Antwerp
April 24, S.S.	*Marena*	April 25,	Newport
April 25, S.S.	*Wheatsheaf*	April 30,	Runcorn
April 25, M.V.	*Annie*	April 30,	Truro
April 25, S.V.	*Via*	*	London
April 26, S.S.	*Hampshire Coast*	April 28,	Liverpool
April 26, S.S.	*Matrero*	*	Buenos Ayres
April 26, M.V.	*San Antonio*	*	Seville
April 27, S.S.	*Carterside*	*	Raumo
April 27, M.V.	*Shamrock*	April 29,	Plymouth
April 27, S.V.	*Englishman*	*	Weston Point
April 28, M.V.	*Mayblossom*	April 29,	Pentewan
April 28, S.S.	*Taycraig*	*	Runcorn
April 28, S.S.	*Agate*	*	Rouen
April 28, S.S.	*Gouwestroom*	*	Amsterdam
April 28, S.S.	*Mersey*	*	Ridham
April 28, S.S.	*Ardri*	*	Weston Point
April 28, S.S.	*Snofrid*	*	Sarpsborg
April 29, M.V.	*Kongedybet*	*	Castlemare
April 29, S.V.	*St. Michel*	*	Odense
April 29, S.V.	*Hilda*	*	London
April 29, M.V.	*Funf Schwestern*	*	Drammen
April 30, S.S.	*Imacos*	*	Milwaukee
April 30, M.V.	*Petite Janine*	—	—

* Signifies "In Port."

Charlestown Shipping—April, 1927

Arrivals

Date.	Vessel.	From
April 1,	*Francis and Jane*	Looe
April 3, S.S.	*Balmyle*	Cardiff
April 3, S.S.	*Porthleven*	Plymouth
April 3, S.S.	*Loch Leven*	Plymouth
April 5, S.S.	*Rivelin*	Exmouth
April 5,	*Mary Ann Mandall*	Newport
April 6, S.S.	*Rosalie*	Padstow
April 6, S.S.	*Cromarty Firth*	Porthleven
April 7, S.S.	*Pegrix*	Penzance
April 7,	*J. H. Barrow*	Glasgow
April 7,	*Kate*	Porthleven
April 8, S.S.	*Dunleith*	Par
April 9, S.S.	*Mourne*	Fremington
April 9, S.S.	*Katharine*	Plymouth
April 10, S.S.	*Edern*	Cowes
April 11,	*Two Sisters*	Newport
April 12, S.S.	*Mango*	Plymouth
April 13, S.S.	*Trader*	Teignmouth
April 13, S.S.	*Grit*	Poole
April 13, S.S.	*James Tennant*	London
April 15,	*La Revanche*	Nantes
April 16,	*Asta*	Par
April 21, S.S.	*Margaret*	Plymouth
April 21, S.S.	*Jolly Laura*	Kingsbridge
April 27, M.V.	*Conrad Luhring*	Dartmouth
April 27,	*C. & F. Nurse*	Truro
April 28,	*Wellington*	Fowey

Sailings

Date.	Vessel.	Destination.
April 4,	*Francis and Jane*	London
April 5, S.S.	*Loch Leven*	Rochester
April 5, S.S.	*Porthleven*	Glasgow
April 6, S.S.	*Rivelin*	Rochester
April 6, S.S.	*Rosalie*	Brussels
April 7, S.S.	*Cromarty Firth*	Tayport
April 7, S.S.	*Balmyle*	Fleetwood
April 8, S.S.	*Pegrix*	Northfleet
April 11,	*Kate*	London
April 11, S.S.	*Dunleith*	Runcorn
April 11, S.S.	*Katharine*	Salcombe
April 14, S.S.	*Mourne*	Runcorn
April 14, S.S.	*Trader*	Rochester
April 14, S.S.	*Mango*	Runcorn
April 16, S.S.	*Edern*	London
April 19, S.S.	*Grit*	Snodland
April 21, S.S.	*James Tennant*	London
April 21,	*Mary Ann Mandall*	London
April 21,	*Asta*	Hamburg
April 21,	*La Revanche*	Nantes
April 22, S.S.	*Margaret*	Preston
April 22, S.S.	*Jolly Laura*	Gravesend
April 29,	*Wellington*	Goole
April 30,	*C. & F. Nurse*	London

Par Harbour Shipping—April, 1927

Arrivals

Date.	Vessel.	From
April 3, S.S.	*Solway Firth*	Newlyn
April 4, S.V.	*Efeu*	Jersey
April 5, S.S.	*Dunleith*	London
April 5, M.V.	*Asta*	Blyth
April 5, S.S.	*Treleigh*	Portreath
April 9, M.V.	*Heather Pet*	Poole
April 15, S.S.	*Marena*	Cardiff
April 19, S.S.	*Multistone*	Salcombe
April 20, M.V.	*Katie*	Mevagissey

April 21, S.S.	*Magrix*	Malpas
April 23, M.V.	*Hope*	Plymouth
April 27, S.S.	*Stanwell*	Plymouth
April 27, S.V.	*Lucy*	Plymouth
April 28, S.V.	*Emma Ernest*	Falmouth
April 28, S.S.	*Wheatlands*	Calais
April 30, S.V.	*Henrietta*	Porthoustock
April 30, M.V.	*Albion*	Plymouth

Sailings

Date.	Vessel.	Destination.
April 2, S.V.	*Guiding Star*	Runcorn
April 5, S.S.	*Solway Firth*	Rouen
April 7, S.S.	*Treleigh*	Preston
April 8, S.V.	*Efeu*	Fredrikshald
April 9, S.S.	*Dunleith*	Charlestown
April 12, M.V.	*Heather Pet*	Rochester
April 16, M.V.	*Asta*	Charlestown
April 19, S.S.	*Marena*	Cardiff
April 20, S.S.	*Multistone*	Gravesend
April 22, S.S.	*Magrix*	Brest
April 24, M.V.	*Hope*	Pentewan
April 29, M.V.	*Katie*	Avonmouth
April 30, S.S.	*Stanwell*	Antwerp

Par Harbour Tide Table, June, 1927

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Wednesday	1	7.8	7.31	13.5
Thursday	2	7.53	8.14	13.0
Friday	3	8.34	8.54	12.4
Saturday	4	9.15	9.36	11.7
Sunday	5	9.58	10.21	10.10
Monday	6	10.44	11.8	10.2
Tuesday	7	11.35	—	9.9
Wednesday	8	0.5	0.38	9.7
Thursday	9	1.13	1.47	9.10
Friday	10	2.19	2.49	10.3
Saturday	11	3.17	3.43	10.10
Sunday	12	4.8	4.31	11.4
Monday	13	4.53	5.14	11.9
Tuesday	14	5.35	5.56	12.1
Wednesday	15	6.16	6.36	12.2
Thursday	16	6.56	7.15	12.3
Friday	17	7.34	7.54	12.4
Saturday	18	8.14	8.34	12.2
Sunday	19	8.55	9.17	11.11
Monday	20	9.39	10.2	11.6
Tuesday	21	10.27	10.54	11.2
Wednesday	22	11.23	11.53	10.10
Thursday	23	—	0.25	10.9
Friday	24	0.59	1.33	11.0
Saturday	25	2.7	2.41	11.6
Sunday	26	3.14	3.45	12.0
Monday	27	4.15	4.44	12.5
Tuesday	28	5.12	5.39	12.8
Wednesday	29	6.5	6.31	12.9
Thursday	30	6.56	7.19	12.9

E. CLEMENS, Harbour Master.

China Clay Imports for April, 1927

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and Northern Ireland from the several countries of consignment during the month of April, 1927, indicates that 6 tons, value £12, were imported from France; and 11 tons, value £27, from Czechoslovakia; the total being 17 tons, value £39.

April Deliveries

Slight Increase on Last Year

WITH a third of the year gone, the total turnover of trade in the three classes of products with which the China Clay industry deals, is still about as far behind (nearly 20,000 tons) last year's total as was the case at the end of three months. While the tonnage dealt with in April showed an increase of 7,000 tons over March, it was only slightly better than the corresponding month of last year, before the strike had had much effect. April turnover last year was swollen by orders in anticipation of the strike, and as May began to show a serious falling-off owing to the same cause, the adverse balance so far experienced this year may reasonably be expected to be overtaken in the next month or two, and good progress made towards reaching the 1925 total. Here are the details of April tonnage together with comparisons with previous months this year and last year :—

Port.	China Clay. Tons. 1927.	China Clay. Tons. 1926.	China Stone. Tons. 1927.	China Stone. Tons. 1926.	Ball Clay. Tons. 1927.	Ball Clay. Tons. 1926.	Totals. Tons. 1927.	Totals. Tons. 1926.
Fowey	59,658	62,525	3,920	2,272	2,316	1,671	65,894	66,468
Charlestown	6,240	3,682	—	—	—	—	6,240	3,682
Par	4,436	4,409	42	656	—	—	4,478	5,065
Penzance	867	1,252	—	—	—	—	867	1,252
Plymouth	655	1,793	—	—	—	—	655	1,793
Falmouth	560	1,572	—	—	—	—	560	1,572
Newhaven	—	—	—	151	—	—	—	151
By Rail	5,301	3,889	—	—	—	—	5,301	3,889
April	77,717	79,122	3,962	3,079	2,316	1,671	83,995	83,872
March	70,854	79,393	5,149	5,333	555	1,	76,558	85,950
February	70,316	81,331	4,033	3,166	2,563	1,	76,912	86,055
January	65,955	66,760	4,375	3,742	2,569	3,	72,899	73,658
4 Months	284,842	306,606	17,519	15,320	8,003	7,09	310,364	329,535

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

ANGLESEY BRICK AND TILE CO., LTD., Llanbedr. Registered April 22, £6,000 debentures; general charge.

BAKER AND CO., LTD., Fenton, earthenware manufacturers. Registered April 21, £8,000 debenture, to C. T. T. Forrester, 1, Baker Street, Fenton, and another; general charge (ranking after mortgage and further charge dated June 14, 1919, and March 15, 1926). *£8,200. January 6, 1927.

ENFIELD (MIDDLESEX) RED BRICK CO., LTD. Registered April 14, Trust Deed dated April 11, 1927, securing £10,000 debenture stock; general charge.

EVERLASTING TILE CO., LTD., London, S.W. Registered April 5, £2,500 debentures, part of £8,000 and premium of 5 per cent.; general charge. *£5,000 debentures. October 25, 1926.

FOREST CHINA CLAY WORKS, LTD., London, E.C. Registered April 12, £5,000 debentures; general charge. *——. August 18, 1925.

GRIMWADES, LTD., Stoke-on-Trent, earthenware manufacturers. Registered April 12, £3,000 further charge, to Building Society; charged on Victory Works, Shelton Old Road, Stoke-on-Trent. *£9,350. April 12, 1926.

SNEYD MILLS, LTD., Burslem, earthenware manufacturers. Registered April 23, £250 charge, to A. Ellis, Weston-super-Mare, and another; charged on land and buildings in Edward Street, Burslem. *Nil. February 18, 1926.

WADE (GEORGE) AND SON, LTD., Burslem, earthenware manufacturers. Registered May 3, £1,200 further charge, to Assurance Society; charged on Manchester Pottery, Burslem, etc. *£2,007 16s. 6d. September 12, 1925.

Satisfactions

BOWATER'S PAPER MILLS, LTD., Northfleet. Satisfaction registered March 29, £25,000, registered June 17, 1926; also satisfaction registered May 2, £25,000, registered June 17, 1926.

REDHILL TILE CO., LTD. Satisfaction registered April 14, £300, registered August 12, 1926.

London Gazette, &c.

Company Winding Up Voluntarily

DEAL POTTERIES, LTD. By special resolution April 12, confirmed April 28. A. J. Worsfold, Market Square, Dover, and P. S. Neylan, Queen Street, Deal, chartered accountants, appointed liquidators, and authorised to consent to registration of a new company to be named Deal Potteries (1927), Ltd.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

China Clay Industry's Future

WELCOME as is the growing volume of trade, marked by the overtaking of the volume recorded last year and approaching that of the record year of 1925, the China Clay industry is not in the flourishing condition it might be. This is due, not to anything inherently amiss in the commodity produced or in the methods of its production, but to the failure of the industry to adequately appreciate and realise the benefits of co-operation and amalgamation.

Though last year's abortive attempt to secure something approaching unanimity in the way of an association has passed into the limbo of history, the failure of certain firms to throw in their lot with the rest to bring to fruition the Lord-Lieutenant of Cornwall's brave effort to lead them into the path of wisdom has proved anything but beneficial to those firms, and has precipitated a number of financial crises with others less strong, whereby shareholders have lost their money and men have been deprived of employment through the closing down of their works.

Three Avenues of Escape

There are three schemes that have been under discussion at different times for the carrying on of the China Clay industry on co-operative lines; that is to say, for the mutual benefit of all concerned as distinct from individual benefit. The first scheme is one for the capitalisation of the whole industry, whereby all firms would be represented in one concern by the holding of shares according to the value of their business. The second scheme involves the setting up of a central selling agency, through which the sales of all producers would take place. The third is a cartel or association, the members of which, while retaining their individual identities, would be subject to the regulations of such association in the matter of quotas of sales and prices.

The Cartel Plan

To review the last-named plan first in relation to the others: No serious attempt has yet been made to secure support for either of the first two schemes, because those who have been inclined to favour them have generally held the view that the only way in which practical effect could be given to capitalisation would be first to secure the adhesion of all producers to the association's plan. The reason for this is that for the most part China Clay producers are somewhat individualistic, and have always shown reluctance to sacrifice their individual interests to any scheme, however attractive it may be. This weakness has been at the root of the failure to set up a really effective central organisation, individual producers having been sticklers for safeguarding their own particular interests, in contradistinction to the interests of the whole industry. The bargaining for concessions by a few producers as a condition precedent to linking up with their fellow-producers in one organisation has been the source of a good deal of resentment on the part of producers who have been prepared to make sacrifices to ensure the well-being of the industry.

Where, as in the China Clay industry, there is a big overproduction of medium and common China Clays, a necessary condition of organisation on an association basis is that the members of it must submit to a quota of sales based on productive capacity. This involves compensation payable by those who oversell their quota as a recompense to those who do not sell up to their quota. It also demands the enforcement of minimum prices for the various qualities of clay. In periods of slump particularly the difficulty has been to know what to do with the clays of producers who have been unable to dispose of their quota. For an association to be really effective, no sales in excess of the quota allotted to any particular firm should be allowed unless such excess sales are met by purchases of the clays accruing to the unsold quotas of other producers. The oversales of certain producers' clays and the undersales of others would then be obviated, and the heartburn caused by excessive sales, always a source of trouble in the old associations, would be avoided. An essential to success is that the individual members composing the association should be prepared to accept and abide by conditions applicable to all equally.

Central Selling

A central selling agency, or a clearing house for the sales of China Clay, is a halfway house between the association idea and the capitalistic idea favoured by some. As this would mean the loss by individual firms of direct contact with their customers, any such scheme would have to possess a guarantee of permanence before producers now dealing direct with consumers would subscribe to it.

Capitalisation

Undoubtedly, the most complete plan for the effective and successful carrying on of the industry, whereby the biggest benefit would accrue to those engaged in the industry and dividends be assured to all financially interested, is that of capitalisation, or the amalgamation of all producers in one operative concern. It has been suggested that the value of individual properties could be arrived at on a comparative basis, a scheme for which any competent firm of accountants could devise. On this basis the present proprietors could be bought out for cash, or shares if they preferred to remain interested in the amalgamated business. Once the "Big Three" in the industry became interested in such a scheme, the embracing of the others might be a comparatively simple matter.

It has been said that to pilot through such an amalgamation would call for the services of a financial expert. There is such a financier in the City of London, well known in the West of England, who has had considerable experience in the carrying through of big schemes, which have proved eminently successful under his regime. What is more, he is financially and productively interested in the China Clay industry, and would therefore bring to the development of a capitalistic scheme inside knowledge, apart from his experience as a financier. So, if the time comes, the industry has at hand a man who can see the thing through to the advantage of all concerned.

The Study of Clays

From the Point of View of Rational Analysis

Amongst the various methods of analysis of clays, raw materials which play a preponderating part in the ceramic industry, that which can give the most conclusive results with regard to the required quality of the clay, is what is styled rational analysis.

Clays, as we know, are not chemically defined bodies, but mixtures in variable proportions of kaolinite, quartz, and felspar, containing in addition to these three fundamental components, small though not always negligible quantities of iron, calcium, magnesium, and titanium, in form of silicates or oxides, and sometimes carbonates. Kaolinite is the component upon which the ceramic properties of the clay depend, viz., plasticity, hardening in fire, refractory quality and, in general, the properties acquired after the action of fire.

Object of Rational Analysis

The object of rational analysis is mainly to estimate the quantity of kaolinite. From the chemical point of view, kaolinite is an alumina hydrosilicate, $2SiO_2$, Al_2O_3, $2H_2O$. Subjected to a temperature of 600° C., it loses some of its weight owing to evaporation of its two molecules of constitutional water, in other words, combined water. Moreover, it undergoes a transformation from the point of view of inorganic acids and bases, the first of which easily dissolve alumina, whereas the bases dissolve the silica of the kaolinite calcined at the temperature in question. It is upon this phenomenon that the Kallauner-Matejka rational method of analysis is based. Another method consists in subjecting the clay to the disaggregating action of hot sulphuric acid which destroys the kaolinite by transforming it into soluble silica and aluminium sulphate. This is the oldest method. It was given by Forchhammer in 1835 and subsequently modified by various scientists, the best known of whom are Seger, Vogt, Lavenard, and Berdel. These different methods more or less alike are disputed from the point of view of accuracy of results. It has, in fact, been proved that as felspar enters into the composition of clays in nearly all cases, it is sometimes disaggregated by hot sulphuric acid, and this may disturb the reading of results and also give rise to errors prejudicial to a judgment of the ceramic quality of the clay.

Various writers have undertaken the task of proving, by experimental work, that the methods of rational analysis, as applied in our laboratories, are quite useless for expert opinion on clays, as their results usually depend upon the greater or less imagination of the experimenter. In a recent article in the *Journal of the American Ceramic Society*, Tilley and Sullivan describe a method by which they try to prove, in support of acquired results, that disaggregation by sulphuric acid affects the kaolinite of the clay as well as the felspar, to such an extent that the value of the analysis is much depreciated if not nullified. Their method is interesting because they experimented on the components of the clay, kaolinite, quartz, felspar, and not on natural clays.

Action of Acid

These component parts were in turn subjected to the influence of hot sulphuric acid until escape of the fumes of sulphuric anhydride. The experimenters noted that the degree of decomposition depends upon duration of the reaction, fineness of the grain, and especially upon the temperature of the reaction. The difference in the results obtained by these various methods were notable. As regards the degree of decomposition, in particular of the felspar, under the action of sulphuric acid, this question was studied by Sullivan and Splichel. The former agitated orthose in sulphuric acid for several days and found 0·6 per cent. as the quantity of dissolved matter. Splichel allowed 200 cubic centimetres of sulphuric acid to act on 20 grammes of orthose for eight weeks. The percentage of orthose dissolved was 1·7 per cent. These experiments made at the ordinary temperature demonstrate that the degree of the decomposition depends upon the length of time during which the acid acts. Should the reaction take place at a high temperature, the action of the acid is manifested by a much greater decomposition.

Tschermak succeeded in completely dissolving orthose by prolonged digestion in boiling sulphuric acid. As previously stated, clay is partially disaggregated by inorganic acids which dissolve the alumina of the kaolinite forming a component part. To determine the variations of the degrees of decomposition of the clays, according to the length of time of the reaction and different degrees of concentration of the acids, Sigmond analysed two samples of the same clay, one of which was subjected, for five days, to the action of hydrochloric acid, diluted and hot, and the second was treated with boiling concentrated hydrochloric acid during ten hours. The results were as follows :

	Clay treated, for 5 days, with hot diluted HCl.	Clay treated, for 10 hours, with boiling concentrated hydrochloric acid.
Na_2O	1	0·44
K_2O	1·25	0·80
CaO	0·96	0·78
MgO	0·58	0·30
Fe_2O_3	2·98	2·10
Al_2O_3	4·62	3·47
Mn_3O_4	0·06	0·04
SO_3	0·12	0·07
P_2O_5	0·21	0·07
SiO_2	10·89	8·27
Fire Loss	8·12	8·23
Insoluble	69·54	75·88

The differences in the results are appreciable and demonstrate that prolonged action of the hot acid has a greater dissolving power than the boiling acid acting during a shorter space of time. Experiments made in the same conditions with sulphuric acid gave almost the same results. Thus it is shown that to obtain harmonious results it is essential to work by methods which do not vary from the point of view of employment of reagents with constant degree of concentration, reacting during invariable periods of time. The result of the experiments described may lead to the conclusion that the value of rational analysis is disputable from all points of view and that the calculated figures are generally erroneous. Nevertheless, it would not be logical to formally deny its technical value for reasons which may be explained as follows :

To estimate the percentage of kaolinite in a clay, quartz, and felspar by a centesimal chemical analysis we must estimate the alkalies to calculate the percentage of felspar, upon which the estimate of the percentages of kaolinite and quartz subsequently depend. This method of work usually leads to errors more prejudicial to expert examination of clay than the errors due to scientific analysis. For example, an error of 0·1 to 0·3 per cent. in estimating the alkalies (a slight error when we consider that the apparatus in the laboratories of works are not always perfectly accurate) leads to an error of 0·58 to 1·37 per cent. in estimating the felspar. The alumina is calculated by subtraction from the amount of felspar, and from the total alumina the percentage of kaolinite, and from the sum SiO_2 of the felspar + SiO_2, the kaolinite, and by subtraction of the total SiO_2, the percentage in quartz. As these results depend upon the percentage of felspar they must of necessity be erroneous if the estimate of felspar is not exact. This method is complicated, and takes time, besides requiring precautions which the chemists of porcelain works are not always in a position to take owing to the absence of suitable platinum apparatus essential for accurate quantitative analysis.

Combination of Rational and Chemical Analysis

A method for analysis of the kaolinite, quartz, and felspar in a clay based on a combination of the rational analysis and chemical analysis, is applied as follows :

After desiccating the clay at 110° C., it is pulverised in a porcelain mortar, taking care not to crush the clayey particles, thus making the degree of fineness of the grain greater than that it naturally possesses. Diluted sulphuric acid (100 cubic centimetres) is then brought to act on 1 to 1·5 gramme of the material. Then the liquid is heated until the escape of sulphuric anhydride fumes, and when cool, diluted with hot water. The insoluble residue is allowed to deposit, after which the liquid is filtered. The residue is then washed in hot

water and treated in a porcelain capsule with a normal potassium or sodium hydroxide solution to dissolve the silica from the kaolinite. The final residue is dried, calcined in a porcelain or platinum crucible and then weighed. The difference between the total weight and that of the insoluble residue gives by a simple calculation the percentage of kaolinite in the clay. The percentage of alumina is estimated in another part of the clay by the usual method for disaggregation, dissolution in hydrochloric acid and precipitation by ammonia. From the percentages of alumina and kaolinite in the clay, those of quartz and felspar can be calculated.

This process is briefly as follows :

Total Al_2O_3 per cent. $-$ Al_2O_3 of the kaolinite $=$ Al_2O_3 of the felspar.

100 per cent. kaolinite—felspar per cent. =quartz.

This method gives very good results, most closely approaching the limit of tolerance applied for this type of analysis.

Nothing has been said regarding the methods employed by various chemists, such as Seger, Berdel, Bollenbach, which are to be found in most books on ceramics.

It is to be hoped, observes M. Leon Schaetner, that the foregoing will prove of some utility in propagating the question of rational analysis, which does not meet with all the attention it deserves. Experiments to find a standard method of analysis are now being made in France, largely contributed to by ceramic chemists, which will soon give a satisfactory result from all points of view.

La Céramique, January, 1927.

China Clay Trade Golf Championship

To the Editor of THE CHINA CLAY TRADE REVIEW.

SIR,—Might I suggest that a China Clay Trade Golf Championship should be held annually, at some convenient golf course, eligible to all members of firms who are connected with the China Clay trade, either as producers or merchants. Really two cups could be played for annually, one for the best scratch score, and one for the best handicap score ; one could be called " The China Clay Trade Championship Prize," and the other " The China Clay Trade Handicap Prize."—Yours, etc.,

R. G. VARCOE.

Varcoes China Clays, Ltd.,
Market Street, Manchester.

China Clay Exports for May

A RETURN showing the exports of China Clay, including Cornish or China Stone, the produce of the United Kingdom, from the United Kingdom to each country of destination as registered during the month ended May 31, 1927 :

COUNTRY OF DESTINATION.	QUANTITY. Tons.	VALUE. £
Finland	4,043	4,876
Estonia	439	428
Latvia	260	409
Sweden	2,895	6,554
Norway	1,493	3,801
Denmark (including Faröe Islands)	733	2,083
Germany	4,084	11,038
Netherlands	3,627	7,954
Belgium	5,551	9,676
France	2,158	3,614
Spain	1,131	3,124
Italy	4,056	7,979
Greece	—	2
Bulgaria	—	11
United States of America	31,364	66,159
Mexico	70	314
Colombia	—	2
Peru	10	46
Brazil	5	23
Argentine Republic	439	613
Irish Free State	1	4
Palestine	—	3
Nigeria (including British Cameroons)	—	2
Cape of Good Hope	3	34
British India	1,768	7,310
Madras	33	142
Bengal, Assam, Bihar and Orissa	274	854
Canada	330	1,388
Newfoundland and Coast of Labrador	2,435	3,226
Total	67,208	141,669

China Clay Quartz

Its Advantage as Concrete Facing

AT the annual meeting of the Eastern District of the Institute of Municipal and County Engineers at Ipswich reference was made to the value of China Clay quartz (the rough particles left after the China Clay had been washed out) as a concrete facing.

The chief feature of interest at the meeting was the paper presented by Mr. Edric Tasker, the chief engineering assistant to the East Suffolk County Surveyor, which dealt with reinforced concrete and had special reference to municipal and county engineering. He pointed out with regard to surface finish that the brushing of concrete, while green, with a wire brush and water, until the surface cement was removed, would expose the aggregate (the substance, stone, granite, etc., which, when bound together by cement, formed concrete) and give relief to flat surface. A sandblast surface could be obtained, similar to that of natural sandstone, but more irregular because of the aggregate.

Tinting Concrete

Meeting the objection to the colour of finished concrete, Mr. Tasker said that at a very little extra cost the drab grey elevation to a structure could be successfully relieved. Either colouring pigments might be added to the concrete—red oxide of iron (ferric oxide) for red, barium chromate or yellow ochre for yellow, azure blue for blue, etc.—or coloured cement might be obtained direct from the manufacturer. Samples of concrete should be made up with the sand and aggregate which were to be employed for the works, as the colour of the sand particularly affected the finish colour of the concrete. If pigments were added, it was important to avoid anything that would destroy the required properties of Portland cement, especially in the way of reducing the tensile strength, or anything which would produce a greasy material, so reducing the bond between the reinforced steel and the concrete, or anything which would act adversely on the steel itself. Reinforced concrete was unique among building materials in combining strength with lightness, and if advantage of this fact were taken remarkable effects in æsthetic design were possible. Mr. Tasker also dealt at length with concrete roads, and, in the subsequent discussion the consensus of opinion was that where there was good bottom to an existing road the reinforcement was largely wasted. Where reinforcement was used it should be placed at the bottom and top if cracking was to be avoided.

Varied Uses for China Clay Crystals

Cordial thanks to Mr. Tasker were proposed by the chairman, and, in seconding the resolution, Mr. A. E. Collins, past president of the Institution and late city engineer of Norwich, pointed out the advantage of precasting members and girders, particularly when building railway bridges, where the minimum of traffic interruption was permissible. As to finish, he said that in Cornwall there was a huge quantity of China Clay quartz, a material which was almost useless, but if that were mixed with cement for the finish of surfaces and then scrubbed down so as to remove the excess cement, they would get a very pleasant appearance, resembling a white granite.

Apropos the above references to the use of China Clay quartz as a facing for concrete, large quantities are now used as the chief aggiegate for concrete blocks for building purposes. A few years ago the Cornwall County Council road surveyor recommended the crystals also for use as a good macadam road binding material.

Clay Convention, 1927

THIS year's Clay Convention is to be held in Bournemouth in September, the official functions commencing on Monday, September 26. There will be various meetings, receptions, conferences, visits to works, excursions, etc., spread over the following days, until Friday, September 30. The headquarters of the Convention will in all probability be the Grand Hotel. The arrangements for the convention are in the hands of a sub-committee consisting of the president, Mr. H. J. C. Johnston, together with Mr. H. G. Montgomery and Mr. H. Halliday. All communications relative to the convention should be sent to H. Halliday, 25, Victoria Street, Westminster, London, S.W.1.

China Clay Notes and News

New Ball Clay Co.

Dorset Brick, Stone, and Ball Clay Co., Ltd.—To carry on the business indicated by the title. Nominal capital, £40,000 in 40,000 preference shares of 10s. and 20,000 ordinary shares of £1. Minimum subscription, seven shares. Directors: D. Lam, 159, Old Christchurch Road, Bournemouth; C. H. Aldersmith, "Fairleigh," Warren Edge Road, Southbourne, Bournemouth; C. A. Hutton, "By the Pines," 37, Nelson Road, Bournemouth West; W. A. Maslen, 20, Grand Avenue, West Southbourne, Bournemouth. Qualification of directors, £100 shares.

China Clay Record Weekly Shipment

The week ending May 13 proved a record shipping week for the port of Fowey. Traffic handled at the Great Western Railway jetties reached the total figure of 22,428 tons for the week, China Clay exports being 20,467 tons and imports of coal 1,961 tons. The previous weekly record was just under 21,000 tons, in May of last year. The record week includes three shipments—over 17,000 tons—to the United States; 5,300 tons to Philadelphia, by the Norwegian s.s. *Jacob Christensen*; 6,750 tons to Boston and New York, by the American s.s. *West Katan*; and 5,500 tons to Portland, Maine, by the British s.s. *Gypsum Prince*.

Apparatus for Grinding China Clay

R. G. Varcoe, Milford, Bramhall Lane, Bramhall, Cheshire; and H. P. Garvey, Roseneath, Crumpsall Lane, Crumpsall, Manchester.—The machine comprises a hopper or shute which, due to gravity, feeds the China Clay to a rotating disc having slots and upon which disc are mounted a series of knives or blades with bevelled edge; the knives or blades are set flat to or are slightly inclined to the disc, and the cutting edge is curved or has its acting edge shaped to a double incline, the cutting edge not completely masking the slots, whereby the clay is cut off and broken and forced through the slots, to a delivery shute. Patent Specification No. 253694. (Three claims.)

China Clay: Use in Margarine Manufacture

It may be as well to remove a wrong impression that has been created by the recent references to the use of colloidal China Clay in margarine manufacture. It has never been suggested by chemists or other authorities that colloidal clay is used as an ingredient in margarine; if margarine manufacturers did so use it they would bring themselves within the scope of the penalties of the Food and Drugs Act. The recent references to the subject are due to a misreading of the information we published some years ago, when Mr. Weston revealed the result of his researches into the uses of colloidal China Clay as a clarifier. In this connection he showed how China Clay in a highly refined colloidal state was being successfully used in soap and margarine manufacture, which is a very different thing from saying that China Clay is an ingredient of margarine.

Sir Charles Cottier's Scholarships

Sir Charles Cottier, well known in Plymouth and the west a few years ago, before he went to London to make a bigger name for himself as a financier interested in the A.B.C., the Criterion Restaurant, and other companies, has founded a scholarship of £65 a year for a Devon boy at University College, Exeter, and is founding another, in conjunction with Mr. Vernon Frank Keeble, for a Devon girl. Sir Charles is financially interested in Hensbarrow China Clays, St. Austell, of which his son is a prominent director. The authorities at Exeter are hoping, of course, that this idea of founding scholarships will spread throughout the west and that some will emanate from Cornwall. Surplus cash might certainly be spent in less remunerative ways than in the founding of these scholarships to give some West of England boys and girls from humble homes a chance of that wider education for which they have shown a capacity in secondary schools

China Clay Port Pictured

If in one of the hundred little boats anchored just off shore, writes a Cornish journalist, you go up the river, past the Town Quay and the Albert Quay, with its grey obelisk, past Pottery Corner and Passage Slip and Caffa Mill Pill, you come at last to the white jetties, to reach which the dozen or so big steamers and the great sailing vessels in the harbour have come to Fowey from distant places. From the eight jetties they will presently be loaded with clay. Thousands of tons of the glistening, white product of Mid-Cornwall are ranged along the riverside in covered trucks. While the trucks are being caught up and tipped so that the clay is shot in a broad, white stream straight into the waiting holds, twenty or thirty others are passing through the station on the way to the jetties. The eight thousand ton American steamer I saw gliding out of the harbour was, I believe, loaded in a week. Always there are eight ships at the jetties, and out in the stream other big steamers are waiting either to load or for the tide that will bear them seaward. And all the time, in view of this immensely important traffic in China Clay, there are developments at Fowey. In 1919 there were thirteen and a quarter feet of water across the bar; now there are twenty-one feet. The harbour is being widened considerably, and there are now a number of berths for ships of from thirteen to fourteen thousand tons. Ultimately it will probably be quite a familiar thing to see a huge sixteen thousand tonner bearing majestically in from sea, and a week later, perhaps, to watch her leaving port bound for America or some other distant overseas port. The China Clay trade at Fowey has already jumped from a coastal and transhipment process into a more significant and economic business. A Cunard ship has been attracted to the harbour, and others no doubt will, in time, follow suit. The basic thing, the export traffic, is there. Who shall say what eventually will be built upon that sure foundation?

China Clay Developments in North Cornwall

Colonel Allen, carrying out China Clay developments at Heneward, St. Breward, appeared before the Camelford Rural District Council and asked that a bridge should be placed over a water splash there. Unless this was done, he could not use the road, over which it was proposed to carry the clay and coal. It was quite evident he must use the road, and came to the Council for assistance in putting a bridge. For the rates he would have to pay, he was entitled to some consideration. If they were not going to rate him, he would not trouble them. He had 15 men employed. If the work were closed down, they would come on the dole, and three weeks' dole would put the bridge up.—Mr. Tucker pointed out that no doubt the Colonel was aware of the conditions when he purchased the property. The Council was not anxious to hinder the development of the district, but they had also to see that the rates did not bear unevenly on the different parts of the district.—Colonel Allen replied that he knew what it would take to put it properly in order. He was not the owner of the road and did not take into consideration the erection of a bridge. The road at present was not usable.

Mr. Tucker remarked that it was suitable for the traffic of the district, and before purchasing the property it was up to the Colonel to ascertain what could be done in the matter he had raised.—Mr. Harte inquired the estimated cost of a bridge and the Colonel replied that it would be a twopenny-ha'penny thing to them.—Mr. Olde: If that is so, why did the Colonel come here for assistance?—Mr. Parnell suggested a committee should inspect and report, and Mr. Tucker pointed out that as other improvement schemes had been turned down, this application could not now be considered.—The Chairman informed Colonel Allen that the Council had passed a resolution that no new work was to be undertaken for six months, but no doubt a committee would meet him and consider if anything could be done to assist him.—Colonel Allen said he would help, but he also wanted them to help. If they said they had no money, he would borrow it for them and make himself responsible. It was decided that a committee meet Colonel Allen on the spot.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay, with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—May, 1927

Arrivals

Date.	Vessel.	From
May 3, S.S.	*Lady Thomas*	Truro
May 4, S.S.	*Trader*	Kingsbridge
May 4, S.S.	*Goole*	Dartmouth
May 4, S.S.	*St. Enoch*	Guernsey
May 4,	*Irish Minstrel*	Falmouth
May 4,	*Gou-Gou*	Cardiff
May 5,	*Gertrude May*	Penryn
May 14,	*Lady Rosebery*	Truro
May 15,	*Gustave*	
May 19,	*Jeanne*	Cardiff
May 19,	*Penryn*	Falmouth
May 19, S.S.	*Jolly Norman*	Plymouth
May 21,	*Sunshine*	Truro
May 22, M.V.	*Linton*	Plymouth
May 22, M.A.	*James*	Falmouth
May 25,	*Shoal Fisher*	Falmouth
May 27, S.F.	*Pearce*	Newport
May 30, M.V.	*Dietrich Hasseldiech*	Weymouth

Sailings

Date.	Vessel.	Destination.
May 2,	*J. H. Barrow*	Leith
May 3, S.S.	*Treleigh*	Manchester
May 4,	*Isabel*	Salcombe
May 4, S.S.	*Lady Thomas*	Fleetwood
May 4, S.S.	*Trader*	Sunderland
May 5, S.S.	*Goole*	Sunderland
May 5, S.S.	*Enoch*	Tayport
May 6,	*Irish Minstrel*	Aberdeen
May 7,	*Two Sisters*	Rochester
May 7,	*Gertrude May*	London
May 17,	*Lady Rosebery*	Rochester
May 17,	*Gou-Gou*	Nantes
May 19,	*Gustave*	Grantham
May 21, S.S.	*Jolly Norman*	Gravesend
May 21,	*Penryn*	London
May 24, M.V.	*Linton*	Antwerp
May 24, M.A.	*James*	Runcorn
May 27,	*Shoal Fisher*	Leith
May 28,	*Sunshine*	London
June 2, M.V.	*Conrad Luhring*	Kotka

Fowey Shipping—May, 1927

Arrived.	Name.	Sailed.	Destination.
May 1, S.S.	*Jacob Christensen*	May 10,	Philadelphia
May 1, S.S.	*Wild Rose*	May 7,	Brussels
May 2, S.S.	*West Katan*	May 12,	Boston
May 3, S.S.	*Gypsum Prince*	May 13,	Portland, Me.
May 3, M.V.	*Henford*	May 7,	Grimsby
May 3, S.S.	*Dorset Coast*	May 6,	Liverpool
May 3, S.S.	*Marena*	May 6,	Glasson Dock
May 3, S.S.	*Ribblemere*	May 7,	Garston
May 3, S.S.	*Goodig*	May 7,	Preston
May 5, M.V.	*Shamrock*	May 6,	Plymouth
May 5, S.V.	*Jane Banks*	May 18,	
May 5, M.V.	*Hela Naval*	May 9,	Harburg
May 5, M.V.	*Advance*	May 10,	Gothenburg
May 6, S.S.	*Sassnitz*	May 10,	Trangsund
May 6, S.V.	*Hejmdal*	May 18,	Gothenburg
May 6, M.V.	*Yealm*	May 10,	Pentewan
May 6, S.S.	*Dagfrid*	May 13,	Nordkoping
May 6, S.S.	*Wheatplain*	May 12,	Runcorn
May 7, S.S.	*Abercraig*	May 10,	Newlyn
May 7, S.S.	*Horn*	May 14,	La Pallice
May 7, S.S.	*Whinhill*	May 14,	Runcorn
May 8, S.S.	*Ferndene*	May 13,	Bilbao
May 8, S.S.	*F. W. Fischer*	May 13,	Kotka
May 8, S.V.	*Boree*	May 23,	Genoa
May 8, S.S.	*Seaforth*	May 9,	Lezardieux
May 8, S.V.	*Thora*	May 19,	Sandviken
May 8, M.V.	*Leeuwerik*	May 14,	Copenhagen
May 10, S.S.	*Gower Coast*	May 14,	Liverpool
May 11, S.S.	*Blush Rose*	May 14,	Runcorn
May 11, S.S.	*Brier Rose*	May 14,	Preston
May 11, M.V.	*Isabel*	May 12,	Pentewan
May 11, M.V.	*Hope*	May 12,	Pentewan
May 11, S.S.	*Hubbastone*	May 14,	Terneuzen
May 12, S.S.	*Mersey*	May 17,	Ridham
May 13, S.S.	*Foynes*	May 15,	Hamburg
May 13, S.S.	*Hillbrook*	May 18,	Milwaukee
May 13, M.V.	*Shamrock*	May 14,	Plymouth
May 14, S.S.	*Hayle*	May 18,	Weston Pt.
May 14, M.V.	*Ocean*	May 19,	Stockholm
May 15, S.S.	*Pansy*	May 18,	Preston
May 15, S.S.	*Treleigh*	May 16,	Pentewan
May 16, S.S.	*Cornish Merchant*	May 27,	Charlestown
May 16, S.S.	*Gouwestroom*	May 20,	Amsterdam
May 18, S.S.	*Sturdee Rose*	May 21,	Brussels
May 18, S.S.	*Hilda*	May 21,	Raumo
May 18, M.V.	*Shamrock*	May 29,	Plymouth
May 19, M.V.	*Katie*	May 30,	Kirkcaldy
May 19, S.S.	*Guelder Rose*	May 23,	Weston Pt.
May 20, S.S.	*Horn*	May 23,	Riga
May 20, S.S.	*Immerhof*	May 24,	Hamburg
May 20, S.S.	*Queen of the Fal*	May 20,	Falmouth
May 20, M.V.	*Shamrock*	May 21,	Plymouth
May 20, M.V.	*Lydia Cardell*	June 1,	Rouen
May 20, S.S.	*Pamela*	May 26,	Liverpool
May 20, M.V.	*Shamrock*	May 21,	Plymouth
May 21, S.S.	*Cranley*	May 24,	Botwood, Nfld.
May 22, S.S.	*Primrose*	May 24,	Runcorn
May 23, S.S.	*Ferndene*	May 25,	Antwerp
May 24, S.S.	*Blush Rose*	May 25,	Weston Pt.
May 25, S.S.	*Emlynmor*	May 26,	Grangemouth
May 26, S.S.	*Brier Rose*	May 27,	Runcorn
May 26, S.S.	*Devon Coast*	May 27,	Liverpool
May 27, M.V.	*Sturwark*	May 30,	Granton
May 27, S.S.	*Pansy*	May 31,	Leith
May 27, S.S.	*Baron Garioch*	June 2,	Boston, U.S.A.
May 27, S.S.	*Mersey*	May 28,	Ridham
May 27,	*Jeanne*	June 2,	Dunkirk
May 29, M.V.	*Kathe Jurgensen*	May 30,	Reval
May 29, S.S.	*Guelder Rose*	June 1,	Preston
May 30, S.S.	*Cape Comorin*	*	Portland, Me.
May 30, S.S.	*Wearbridge*	*	Philadelphia
May 30, S.S.	*Hayle*	June 1,	Birkenhead
May 30, S.S.	*Ruth*	*	Christiansand
May 31, S.S.	*Cornish Merchant*	*	Brussels
May 31, S.S.	*Fairland*	June 2,	Liverpool

* Signifies "In port."

Par Harbour Shipping—May, 1927

Arrivals

Date.	Vessel.	From
May 1, M.V.	*Grit*	London
May 4, S.V.	*Fanny Crossfield*	Falmouth
May 6, M.V.	*Shortest Day*	Plymouth
May 6, S.S.	*Tanny*	Penryn
May 9, S.V.	*Flying Foam*	Falmouth
May 11, S.V.	*Lady Agnes*	Polperro
May 12, S.V.	*My Lady*	Port Nevis
May 12, S.S.	*Wheatcrop*	St. Malo
May 13, M.V.	*Saltash*	Plymouth
May 13, M.V.	*Renmis*	Portsmouth
May 14, S.S.	*Balmyle*	Cardiff
May 14, S.V.	*Emma and Ester*	Falmouth
May 14, S.S.	*Frivole*	Fowey
May 15, S.S.	*Grosvenor*	Treport
May 15, S.V.	*Kate*	Truro
May 17, M.V.	*Gaelic*	Dartmouth
May 19, M.V.	*Grit*	London
May 20, S.V.	*Hero*	Falmouth
May 22, S.S.	*Ferndene*	Bilbao
May 23, S.V.	*Winifred*	Plymouth
May 24, S.V.	*Guiding Star*	Gweek
May 25, M.V.	*Capable*	Torquay
May 26, M.V.	*Shortest Day*	Plymouth
May 26, S.S.	*Wheatplain*	Brest
May 27, S.S.	*Catherine*	Kingsbridge
May 27, S.S.	*Moralie*	Torquay
May 28, S.S.	*Condor*	Plymouth
May 28, S.V.	*Snowflake*	Mevagissey
May 31, S.S.	*Treleigh*	Charlestown

Sailings

Date.	Vessel.	Destination.
May 2, S.S.	*Wheatlands*	Preston
May 3, M.V.	*Grit*	Rochester
May 4, S.V.	*Emma and Ernest*	London
May 4, M.V.	*Albion*	Rochester
May 5, M.V.	*Helina Anna*	Weston Point
May 5, S.V.	*Lucy*	Queenborough
May 7, M.V.	*Shortest Day*	Salcombe

May 7,	S.S. *Tanny*	Bristol
May 14,	S.V. *Flying Foam*	Runcorn
May 14,	M.V. *Saltash*	Plymouth
May 15,	S.S. *Wheatcrop*	Larne
May 16,	S.V. *Fanny Crossfield*	Leith
May 16,	S.S. *Balmyle*	Roscoff
May 17,	S.V. *My Lady*	Runcorn
May 17,	S.S. *Grosvenor*	Lancaster
May 17,	S.V. *Kate*	Plymouth
May 18,	M.V. *Renmis*	Antwerp
May 20,	S.V. *Frivole*	Roscoff
May 21,	M.V. *Grit*	Pentewan
May 23,	S.V. *Henrietta*	Weston Point
May 23,	S.S. *Ferndene*	Fowey
May 26,	S.V. *Winifred*	Plymouth
May 27,	M.V. *Gaelic*	Runcorn
May 27,	S.V. *Hero*	Runcorn
May 27,	M.V. *Capable*	Rochester
May 27,	M.V. *Shortest Day*	Plymouth
May 28,	S.S. *Katherine*	Plymouth
May 29,	S.S. *Wheatplain*	Preston
May 31,	S.V. *Lady Agnes*	Kirkcaldy
May 31,	S.S. *Marallie*	Rouen

Par Harbour Tide Table, July, 1927

(British Summer Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Friday	1	7.41	8.1	12.7
Saturday .	2	8.21	8.41	12.2
Sunday ..	3	9.0	9.19	11.8
Monday ..	4	9.38	9.58	11.3
Tuesday...	5	10.17	10.37	11.9
Wednesday	6	10.57	11.19	10.3
Thursday..	7	11.43	—	9.11
Friday ..	8	0.9	0.37	9.9
Saturday .	9	1.7	1.39	9.10
Sunday ...	10	2.12	2.45	10.2
Monday ..	11	3.16	3.45	10.8
Tuesday...	12	4.12	4.38	11.3
Wednesday	13	5.3	5.27	11.9
Thursday..	14	5.51	6.15	12.2
Friday	15	6.38	7.0	12.4
Saturday .	16	7.22	7.43	12.8
Sunday ...	17	8.4	8.25	12.9
Monday ..	18	8.46	9.7	12.8
Tuesday...	19	9.29	9.52	12.5
Wednesday	20	10.15	10.39	12.0
Thursday..	21	11.4	11.30	11.6
Friday	22	11.57	—	11.0
Saturday .	23	0.26	0.58	10.9
Sunday ...	24	1.33	2.11	10.10
Monday ..	25	2.49	3.25	11.2
Tuesday...	26	4.0	4.33	11.8
Wednesday	27	5.4	5.33	12.1
Thursday..	28	5.59	6.23	12.3
Friday	29	6.46	7.7	12.4
Saturday .	30	7.27	7.46	12.6
Sunday ..	31	8.4	8.21	12.4

E. CLEMENS, Harbour Master.

May China Clay Deliveries

Last Year's Total Exceeded

As we predicted last month was likely to be the case, with the deliveries of China Clay, China Stone, and Ball Clay made in May, the total volume of trade for the year has now overtaken that for the corresponding five months of last year, the balance in favour of this year being 14,920 tons. Compared with the corresponding period of 1925, a record year, the figures are down by only 14,920 tons on the total, and 18,230 on China Clay alone. The statistics below show how greatly in excess was the tonnage over May of last year, in which month the effect of the coal strike was beginning to be felt. Details :

	China Clay.		China Stone.		Ball Clay.		Totals.	
Port.	Tons. 1927.	Tons. 1926.	Tons. 1927.	Tons. 1926.	Tons. 1927.	Tons. 1926.	Tons. 1927.	Tons. 1926.
Fowey ...	58,954	33,731	5,216	1,118	893	1,412	65,063	36,261
Par	4,720	3,313	1,005	120	—	—	5,725	3,433
Charlestown	4,583	4,109	—	—	—	—	4,583	4,109
Penzance ..	855	250	—	—	—	—	855	250
Plymouth..	450	287	—	—	—	—	450	287
Falmouth	505	100	—	—	—	—	505	100
By Rail ..	4,043	2,693	—	—	—	—	4,043	2,693
May	74,110	44,483	6,221	1,238	893	1,412	81,224	47,133
April	77,717	79,122	3,962	3,079	2,316	1,671	83,995	83,872
March	70,854	79,393	5,149	5,333	555	1,224	76,558	85,950
February ..	70,316	81,331	4,033	3,166	2,563	1,558	76,912	86,055
January ..	65,955	66,760	4,375	3,742	2,569	3,156	72,899	73,658
5 months	358,952	351,089	23,740	16,558	8,896	9,021	391,588	376,668

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

CLYNE VALLEY BRICK AND TILE CO., LTD., Swansea. Registered May 16, £12,000 debentures (filed under sec. 93 (3) of the Companies (Consolidation) Act 1908), present issue £11,200; general charge. *Nil. May 7, 1926.

DEAL POTTERIES (1927), LTD. Registered May 23, £2,800 debentures; general charge.

REDFERN AND DRAKEFORD, LTD., Longton, china manufacturers. Registered May 21, £3,000 debentures; general charge. *Nil. September 22, 1926.

SHILTON BRICK AND TILE CO., LTD., Coventry. Registered May 17, £5,000 debentures; general charge.

TORQUAY POTTERY CO., LTD. Registered May 14, £500 (not ex.) mortgage to bank; charged on Royal Torquay Pottery, Hele Cross, Torquay, and Haytor Vale Pottery, Bovey Tracey. *£3,000. May 22, 1926.

YORKSHIRE PAPER MILLS, LTD., London, W.C. Registered May 6, mortgage and charge, to bank; charged on Dearne Paper Mill and Bleach Works, Barnsley, also general charge. *Nil. April 28, 1927.

Satisfactions

ANGLESEY BRICK AND TILE CO., LTD., Llanbedr. Satisfaction registered May 9, £2,000, registered May 28 and July 2, 1926.

BOWATERS PAPER MILLS, LTD., Northfleet. Satisfaction registered May 9, £175,000, registered October 10, 1924.

MEAKIN (J. AND G.), LTD., Hanley, earthenware manufacturers. Satisfaction registered May 19, £12,200, part of amount registered May 3, 1909.

REDHILL TILE CO., LTD. Satisfaction registered May 11, £800 (not ex.), registered October 28, 1926.

ROBINSWOOD HILL BRICK AND TILE WORKS, LTD., Tuffley. Satisfaction registered May 14, £4,850, registered November 3, 1909.

SHACKLETON (JAMES) AND SON, LTD., Bradford, paper manufacturers. Satisfaction registered May 24, £5,000, outstanding July 1, 1908.

WADE (GEORGE) AND SON, LTD., Burslem, china manufacturers. Satisfaction registered May 20, £554 5s. 10d., part of amount registered May 21, 1921.

Exhibit of Colloidal Clay

AN exhibit of colloidal clay, "Osmo" Kaolin, prepared from the finest English China Clay by an electro-osmotic process, on the stand of the Fuller's Earth Union, attracted much interest at the International Oil, Chemical, and Colour Trades Exhibition, which closes at the Royal Agricultural Hall to-day. It is an exceedingly fine preparation, the particles being no larger than the size of the more common bacteria; moreover, it is entirely neutral. Microscope slides were on view showing the relative sizes of the particles of the colloidal clay and of the crystal and other particles which were removed in the process of preparation. Experiments showing its power of absorption and its colloidal character were also shown.

China Clay Imports for May

A RETURN showing the registered imports of China Clay, including China Stone, into Great Britain and Northern Ireland during the month of May, 1927, indicates that the imports were nil.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.*

A New Direct Cotton Black

CHLORAZOL Black P.B. is the latest addition to the British Dyestuffs Corporation's range of direct cotton blacks. It gives reddish shades of black and is applicable to all types of cotton materials. Chlorazol Black P.B. is essentially designed for the dyeing of cotton piece goods, for which purpose it is said to have acquired a big reputation with piece dyers. In addition, it possesses excellent cold dyeing affinity, being particularly suitable for burl dyeing unions composed of wool and cotton or silk and cotton. In the manner usual for direct cotton colours, it is dyed from an alkaline bath, with an addition of common salt or Glauber's salt.

Standardising Dye Fastness

CONSIDERABLE interest will be taken in the work of the German Commission on standardisation of colour fastness which is to be described by Dr. Paul Krais at a meeting of the West Riding Section of the Society of Dyers and Colourists on February 10. Dr. Krais, who acted as chairman of the Commission, is coming over from Germany specially for the address, and should have something interesting to say. He was formerly resident for many years in Bradford, holding a responsible post with a large firm of dyers, and is well known in the district.

Dyers' Wages

THE question of dyers' wages has been raised by the proposal of the employers that the Mackenzie Award made in 1924 of 2s. to male and 1s. 3d. to female operatives, should be withdrawn on the ground that the conditions justifying the award no longer exist. The employer, have intimated their willingness to submit the matter to arbitration and to defer the effect of any new award for practically three months. From the operatives' sides it is contended that the benefits to the employers from the withdrawal of the award would not be material, while the effect on the workers would be seriously felt, and might be productive of discontent. About 80,000 operatives (50,000 male and 30,000 female) are affected by the po - posals. The Joint Dyers' Executive is to meet in Manchester on Saturday, January 22, to consider the matter.

Production of Coal Tar Dyes

A RECENT paper by Mr. H. E. F. Tracey, B.A. (Cantab.), A.I.C., A.M.I.Chem.E., before the Hull Chemical and Engineering Society, described in very practical terms the production of coal tar dyes with reference to some of their chemical engineering problems. He took as the basic illustrative colour for the address Direct Deep Black E extra, for the reasons that four intermediates are required for its production, that the manufacture of the colour may be entirely self-contained (that is, that starting from the original raw materials the finished colour may be produced without being troubled with any by-product), and that the colour is a very important one, used in large quantities. The annual world consumption is probably nearly 50,000 tons. The process up to the final stage was traced in detail, and it was stated that on a rough compilation 25 to 30 tons of chemicals are used for every ton of standard dye produced.

New Synthetic Fibre Yarn

THE discovery and manufacture of a new synthetic fibre yarn is announced by the Fitchburg Yarn Co., of Fitchburg, Mass., as the result of experiments begun last March by their engineer assisted by a Swiss textile expert. Although the process and formula have not been disclosed, it was said that the new product has a cellulose base. Because of this, it presents some dyeing problems, but it is said to have been subjected satisfactorily to warp dyeing, in which it differs from rayon. Independent tests are now in progress.

U.S.A. Dyes Census

THE *Census of Dyes and Other Synthetic Organic Chemicals* for 1925, issued by the United States Tariff Commission, Washington, is a volume of 224 pages and contains an immense amount of statistical and general information. It presents the results of a special investigation made by the United States Tariff Commission with respect to the production in the United States of coal-tar dyes and synthetic organic chemicals, both of coal-tar and of non-coal-tar origin. It includes a detailed tabulation of the coal-tar dyes imported into the United States, and official statistics of imports and exports of coal-tar dyes by the large consuming and producing nations of the world. A special chapter on the cost of the dyestuffs used in the manufacture of representative fabrics and garments bears out generally the conclusions on this interesting topic noted in our last dyestuffs supplement. Those who desire to study the complete report may obtain copies from the Superintendent of Documents, Government Printing Office. Washington, D.C., at 30 cents per copy.

American Spring Colours

FOURTEEN colours for spring knitted outerwear garments have recently been selected by the U.S.A. National Knitted Outerwear Association. The shades are taken from the Spring 1927 Colour Card of America, issued by the Textile Colour Card Association of the United States. These colours have been selected " after a careful survey of those to be used by the allied trades, including the millinery, hosiery, and leather industries."

The card is divided into seven bright and seven pastel shades. " Nectar," a muted pink lavender, favoured by Paris milliners, is an original modish pastel hue. " Wild Cherry," the raspberry colour sponsored by Chanel, may be one of the leading colours this spring. It matches " Wild Raspberry " on the 1927 Spring Colour Card. " Blue Jewel " is a bright light blue, harmonising with " Blue Turquoise," selected by the Millinery Associations as a fashionable shade for their winter resort models. The Spanish note is seen in " Golden Poppy," a brilliant orange. An unusual shade of pinkish terra-cotta tone, called " Marsh Rose," suggests the soft tints of a Pompeian fresco.

For sport sweaters, " Popcorn," a light yellow, " Mother Goose," a neutral beige tan, and " Gooseberry Green," a light apple green, are fashionable shades as well as the delicate " Cameo Pink." Blues occupy an important place—the dull silvery " French Blue," in the more intense indigo shade called " Liberty Blue " and the pastel greenish blue called " Vert de Gris." These blues will be especially popular this spring, according to Margaret Hayden Rorke, managing director of the Textile Colour Card Association.

Dyestuff Licences for December

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during December, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee. The total number of applications received during the month was 552, of which 446 were from merchants or importers. To these should be added 11 cases outstanding on November 30, making a total for the month of 563. These were dealt with as follows :—Granted, 444 (of which 427 were dealt with within 7 days of receipt) ; referred to British makers of similar products, 54 (of which 46 were dealt with within 7 days of receipt) ; referred to reparation supplies available, 3 (all of which were dealt with within 2 days of receipt) ; outstanding on December 31, 62. Of the total of 563 applications received, 478, or 85 per cent., were dealt with within 7 days of receipt.

Wetting-out Agents in Bleaching and Dyeing

By A. J. Hall, B.Sc., F.I.C., F.T.I.

In the following article information is given as to how some of the newer synthetic products are being utilised in textile processes.

For many years the natural resistance of textile fibres to wetting when immersed in aqueous solutions has existed as a real difficulty in textile processes. The slow penetration of cotton piece goods by cold mercerising liquors, the uneven wetting of loose wool in scouring machines, and the imperfect saturation of wool with acid solutions in processes of carbonisation are well known as hindrances to efficiency. In general, such difficulties have been met by the use of hot or boiling liquors, but such a remedy is not possible in many cases. Now, however, thanks to the cheap production of synthetic products, these difficulties may be solved in a more reasonable manner.

Within recent years it has been discovered that comparatively small quantities of certain compounds assist the penetration of textile fibres to an extraordinary degree. For instance, if a piece of woollen fabric, say 4 × 4 cms., is thrown on the surface of a carbonising liquor (sulphuric acid of 6° Tw.) penetration is so slow that the fabric takes about 15 minutes before it sinks. On the other hand, under similar conditions woollen fabric sinks within 30 seconds in the same liquor containing 10 grams per litre of the proprietary wetting-out substance known as Leonil S. Such rapid wetting out of textile materials is of the utmost importance.

In general it is found, in processes of textile treatment in which wetting-out agents are used, that the treatment may be carried out more rapidly and thoroughly, and as a result the substances used in the treatment are utilised more efficiently. It is, for example, found that when wetting-out agents are added to carbonising liquors, the strength of the latter may be reduced without loss of effect. Again, in processes in which textile fabrics are impregnated with a dye liquor by passage through a padding mangle, the addition of a wetting-out agent to the liquor enables the rate of passage of the fabric through the mangle to be increased, and usually the concentration of the dye must be somewhat reduced.

Present Low Standard of Efficiency

The low standard of efficiency of penetration found in works processes is not generally realised. Anyone who examines dyed fabric by pulling out separate threads and untwisting them will realise how superficial is the dyeing ; the interior fibres of each thread will generally be colourless or unevenly dyed. These defects are particularly evident by microscopical examination. Mercerised yarns are often found to be mercerised only externally, the inner fibres being twisted and ribbon-like, thus showing their non-contact with the mercerising liquor. Even in dyed fabrics which have been subjected to ageing or steaming processes, penetration is often lacking. The result of such inefficient treatment is lack of fastness to light (in the case of dyed materials), " flecky " or bare appearance, and unevenness in the finished state. Hence the opportunity which exists for those who can devise means for easily overcoming these defects.

At the present time over one hundred proprietary substances are being sold for assisting the wetting-out of textile materials. Most of these substances have originated in Germany, as such names as Nekal, Isomerpin, Diffusil, Flerhenol M, Verapol suggest, and they are prepared suitable for all kinds of textile processes. Generally those wetting-out agents stable and effective in acid liquors are distinguished from those suitable for alkaline liquors.

The composition of the various wetting-out agents now available is more or less unknown—an opportunity for students at universities and colleges thus exists for assisting industry by determining their identity—except in certain instances. The earliest wetting-out agent known as Tetracarnite (Sandoz) is believed to consist essentially of pyridine and a sulphonated oil (Turkey red oil) and was first suggested by Freiberger. Since the introduction of Tetracarnite, sulphonic acids of benzene, naphthalene, and their hydrogenated derivatives have been found especially serviceable in this direction. Many wetting-out agents are mixtures of soaps or sulphonated oils with organic solvents (tetrachlorethane, trichlorethylene, etc.) or aromatic compounds.

Searching for the Perfect Wetting-out Agent

Since a wetting-out agent may contain an organic solvent or soap, it is at once evident that a wetting-out agent may be something more than a wetting-out agent—it may also be useful for removing fatty substances from textiles, or for assisting the solution of dyestuffs when employed in dye liquors. Thus Tetralene contains an organic solvent capable of emulsifying or dissolving waxes in cotton and is therefore useful as an assistant in keiring. Similarly Tetracarnite has a solvent action for vat dyestuffs, and is useful as an addition to vat dye liquors for removing any scum of oxidised dye which may be present. The ideal wetting-out agent and one which will find most favour in textile processes is one which is able to dissolve or emulsify fats and waxes in textile materials, which can increase the dispersion of dyes in dye liquors, which effects rapid penetration and which can be used in acid, neutral or alkaline solution. At the moment, practically no wetting-out agent can claim all these properties, but that is probably only a matter for further investigation by producers of synthetic products.

It is as yet too early to foresee the type of compound which will eventually prove to have the greatest all-round use for wetting-out purposes, but indications may be obtained by reference to the products actually now in use and those under investigation. A recent patent (E.P. 252392) protects the use of aromatic sulphonic acids which contain at least one alkyl group and at least one halogen atom, nitro, hydroxyl, or amino group. One example of such a compound is obtained by sulphonating α-chloronaphthalene and condensing the product with *iso*propyl alcohol. It is suitable for wetting-out wool and assists the lathering of soap solutions. Di-amyl-α-naphthylamine sulphonic acid and diethyl metanilic acid are useful substances for promoting the dispersion of dyes in dye liquors. A wetting-out agent having good scouring properties consists of a mixture of methyl-cyclohexanone and the sodium salt of di-butylaniline sulphonic acid.

The use of hydrogenated aromatic compounds is also protected in E.P. 252811. Such compounds include tetra and hexa-hydronaphthalene sulphonic acids, it being also possible to condense these substances with fatty acids such as oleic acid or products obtained from olive and cotton seed oils. All these compounds reduce the surface tension of aqueous solutions, and promote the removal of fatty substances from greasy fibres. One distinct advantage of such hydrogenated naphthalene compounds lies in the fact that they may be used for the scouring of wool at higher temperatures than may be employed with the usual soap solutions, since they do not assist felting. Thus a botany wool may be scoured by means of these products at 60° C. instead of 50° C.

Wetting-out agents are also obtained by condensing sulphonated phenols or naphthalene sulphonic acids with formaldehyde (E.P. 246468). Aliphatic substituted sulphonic acids are protected in E.P. 246155 as wetting-out agents suitable for use in the bleaching of textile materials. Such compounds include palmitobenzenesulphonic acid, stearotoluenesulphonic acid and isopropylnaphthalenesulphonic acid and their salts.

Emulsions of chlorinated aliphatic hydrocarbons and sulphonated fatty acids are also useful wetting-out agents.

Users' Difficulties

One of the chief difficulties which confronts users of wetting-out agents is that of being able to decide which agent to use for any particular purpose: the number of wetting-out agents available is so large. Ultimately it is, of course, necessary to test the wetting-out substance under the conditions of the actual textile process, but more rapid and convenient methods of testing are desirable. Wetting is related to surface tension, viscosity, capillarity and emulsification, and it is extremely difficult to devise tests which involve all these physical properties. Two tests do appear, however, to be more valuable than others.

The first method of comparison of various wetting-out agents is carried out by observing the times taken by a standard piece of textile material to sink in aqueous solutions of the wetting-out agents. The textile material is chosen according to the use to which the wetting-out agent is to be employed—it may be of cotton, wool, or silk. Preferably it is in the form of fabric, since this can be easily cut into a number of pieces similar in weight and surface area. Among those who have utilised this method may be mentioned Kind and Auerbach (Textilberichte, 1926, 7, 775), and their results afford interesting data concerning many of the wetting-out agents now available to bleachers and dyers.

For the carbonisation of wool, Leonil S, Nekal A pdr, Neomerin N and Oranit pdr are suitable wetting-out agents, since they are soluble in the acid liquor employed. The following results with these substances are given as showing the general working of the method—using pieces of woollen fabric 4 by 4 cms.

Wetting-out agent.	Temperature of solution (sulphuric acid of 6° Tw.) 16° C.	30° C.	50° C.
	Duration of sinking of fabric.		
Leonil S.			
10 g./litre	32 secs.	10 secs.	4 secs.
5 ,,	47	15	7
3 ,,	50	16	10
2 ,,	55	22	13
Nekal A pdr.			
10 g./litre	4	3	2
5 ,,	7	4	3
3 ,,	11	7	4
2 ,,	16	9	4
Neomerpin N			
10 g./litre	5	3	2
5 ,,	15	6	3
3 ,,	20	9	5
2 ,,	25	11	6
Oranit pdr.			
10 g./litre	3	2	1
5 ,,	5	4	2
3 ,,	7	5	2
2 ,,	10	7	3

In acid alone at 16° C., duration of sinking—900 secs.

The above results indicate the superior wetting-out properties of Oranit pdr and Nekal A pdr under carbonising conditions. It is, indeed, claimed for Oranit KS that it allows the strength of carbonising acid to be reduced from 6·7° Tw to 4·5° Tw.

There is a very definite scope for wetting-out agents in the mercerisation of cotton yarns and fabrics, so that the following results obtained by the same method are useful as well as interesting.

Wetting-out agent.	Quantity of agent per litre of mercerising liquor. 5 g.	3 g.	2 g.	1 g.
	Duration of sinking of fabric.			
Nekal A	65 secs.	130 secs.	210 secs.	290 secs.
Transferin	215	245	300	328
Tetracarnite	103	230	280	435
Neomerpin	80	150	240	300

In mercerising liquor alone, duration of sinking—450 secs.

Some further results obtained by this method by Auerbach (Textilberichte, 1926, 7, 681), and which serve to compare the wetting-out powers of a number of proprietary substances, are given below.

Wetting-out agent.	Duration of sinking of fabric. Concentration—5 g./litre. Temp. 16° C
Eufullon	exceeding 1 hour.
Flerhenol M	8·3 mins.
Isomerpin	73 mins.
Marseilles soap	52 mins.
Monopole soap	146·5 secs.
Nekal A pdr.	12·2 secs.
Neomerpin N	21·7 secs.
Neomerpin NSL	25·3 mins.
Oranit	16·2 secs.
Oranit FW	62·3 secs.
Sulphonade	560 secs.
Tetracarnite	exceeding 90 mins.
Turkey red oil	26·7 mins.
Verapol	exceeding 3 hours
Alcohol	exceeding 2 hours
Sodium carbonate	exceeding 2 hours

The second method of comparison of wetting-out of agents consists of determining the drop-number of their aqueous solutions. When water is allowed to fall from a pipette, the size of the drops is mainly dependent on the surface tension of the liquid. The larger the surface tension, the larger the drop, and *vice versa*. If, therefore, equal volumes of two different liquids are successively allowed to fall from a pipette (known in its standardised form as a stalagmometer), their surface tensions may be compared by means of the numbers of the drops formed by each liquid. The number of drops which a liquid forms in falling under such standard conditions is usually known as its drop-number. Since a characteristic of wetting-out agents is that they lower the surface tension of the aqueous liquor to which they are added, their wetting-out powers are proportional to the drop-numbers of their aqueous solutions.

Kind and Auerbach obtained the following results by this method, and they should be considered in relation to the fact that Nekal, Leonil, Oranit and Neomerpin N are derived from alkylated naphthalene sulphonic acids, whereas Tetrapol, Koloran and Flerhenol M are mixtures of sulphonated oils and organic solvents.

Wetting-out agent.	Drop-number at 17° C. Concentration of solution—5 g./litre.
Atmosol	45
Koloran	62
Diffusil	61
Diffusil N	87
Diffusil T	46
Eufullon W	48
Flerhenol M	63
Hydraphtal	57
Isomerpin	59
Kernseife	91
Leonil S	43
Marseilles soap	94
Monopole soap	66
Nekal A pdr	65
Neomerpin N	62
Oranit pdr	66
Oranit FW	56
Perpentol	38
Sulfonade	60
Tetrapol	58
Tetracarnite	40
Turkey red oil	63
Transferin	40
Verapol	85
Verapol soap	81

It will be noticed in the above table that Turkey-red oil—one of the oldest wetting-out and emulsifying agents used in dyeing and printing—has a very low drop-number compared with many of the newer substances. This low drop-number indicates, of course, that aqueous solutions have their surface tension lowered to a comparatively small extent by the addition of Turkey-red oil.

The results obtained by the two methods outlined above do not always confirm each other, and one can see, on reflection, that neither method is perfectly satisfactory. Yet taken together, the "sinking fabric" and drop-number methods are the best means available for comparing the wetting-out

powers of the various compounds now being sold. On the whole, that method in which the sinking of a fabric is utilised appears to be most reliable in relation to works processes.

From the above, it will be realised that wetting-out agents have possibilities of giving great assistance to the textile industries. There can be no doubt that wetting-out agents —once a curiosity—have come to stay. It is up to English dye and chemical manufacturers to cultivate this field and produce wetting-out agents which may be utilised under all conditions of textile treatment and at a cheap price.

Basic Intermediates for Dyestuffs: No. VI.—Anthraquinone

By "Consultant"

AMONG the really fundamental dyestuff intermediates there are few that have more importance than anthraquinone. The basis of a vast series of vat dyestuffs, important alike for their purity of colour and fastness to light, it and its simple derivatives are produced in very large quantities.

The various methods for the production of anthraquinone may be divided broadly into two classes: those involving the oxidation of anthracene, and the more interesting, although, at present, technically less important, synthetic methods involving naphthalene as the ultimate raw material. Among the various oxidation materials for converting anthracene to anthraquinone, chromic acid is probably the most popular and widely used, and its use involves the reaction :—

$$C_{14}H_{10} + Na_2Cr_2O_7 + 4H_2SO_4 = C_{14}H_8O_2 + Cr_2(SO_4)_3 + Na_2SO_4 \underset{5H_2O}{}$$

Other oxidation materials and processes have been used, several of which will be discussed later. Although, of course, almost as many modifications of the chromium oxidation process exist as there are works producing anthraquinone, they vary but little from the following procedure. The actual oxidation is performed in a capacious lead-lined vessel holding from 2,000 to 3,000 gallons and fitted with a lead covered stirrer and lid. Sublimed anthracene (2½ cwt.) and water (400 gallons) are mixed in the tank and warmed by blowing in low pressure steam to a temperature of 75° C. A solution containing sodium dichromate (5 cwt.) and sulphuric acid (10 cwt.) in water is slowly added with considerable stirring, the temperature rising meanwhile to about 95° C. The amount of water employed in the manufacture of the chromic acid solution varies with the purity of the anthracene used. A pure grade of anthracene does not give rise to frothing so easily as a low grade material, so that less water is necessary with the purer anthracene. In practice it is customary to use a comparatively dilute solution since the yield is thereby increased. For the quantities just mentioned the chromic solution would probably be diluted to about 800 gallons, the addition of which would take from 12 to 16 hours. The process may be varied by adding the dichromate to the water and anthracene and running in the slightly diluted acid, but this process is held by some to cause more frothing than when the chrome liquor is prepared separately.

After the addition of chromic acid is complete the solution is brought to the boil and maintained there for some time in order to complete the oxidation. The end of the reaction can be adjudged in several ways. The remaining chromic acid may be estimated with ferous sulphate or, as is more popular, a sample may be withdrawn filtered and sublimed; the eye soon learns to detect the point at which the flat plates of anthracene cease to appear among the needles of anthraquinone. When oxidation is complete the reaction mixture is filtered, pressed hot, and washed with hot water. The yield of this crude anthraquinone varies from a 100 to 110 parts from each 100 parts of anthracene used.

There are numerous disadvantages which make this process an economically difficult one. In the first place the present demand for a pure anthraquinone compels the utilisation of a high grade anthracene which in itself is difficult to obtain. In the second place the recovery of the chromium salt is by no means economically simple and must be carried out in order to make the process pay. Thus, in order to get anthracene of the requisite degree of purity and state of subdivision for anthraquinone manufacture, the following operations have to be performed. The coal tar distillate obtained between 270° C. and 400° C. is allowed to stand for several days, after which the separated anthracene is removed by centrifuging and is pressed hot. This crude anthracene contains 40 to 50 per cent. of the desired compound together with carbazole and phenanthrene. It is heated with a few times its weight of pyridine bases to 100° C.—solution at that temperature complete, but on cooling practically pure anthracene separates out. The sludge is centrifuged and the operation repeated when a 90 per cent. anthracene is obtained. This is sublimed with steam at 200° C. in order to obtain the necessary state of subdivision.

Concerning the utilisation of the chromium liquors there are two main possibilities, firstly the conversion to chrome alum, chromium acetate or chromium fluoride, all of which are used in dyeing or tanning, or secondly, reconversion to chromate for use with further batches. If the latter course is taken two main methods offer themselves. In the first of these milk of lime is added in quantity sufficient just to precipitate the sulphuric acid present, and to the filtered liquid more milk of lime is added to precipitate the chromium. The precipitated chromium-lime mud is fused to chromate in the usual way. The second method is electrolytic in nature, the green chromium liquors being boiled down until that concentration is reached, which will, after electrolysis, yield a solution strong enough for the oxidation of another batch of anthracene. The liquor flows through a battery of lead lined electrolytic cells undergoing oxidation, and emerging fully oxidised to the dichromate stage. It is estimated that the recovery of 1 cwt. of dichromate requires 270 kilowatt/hours at 3·5 volts.

Other Oxidation Processes

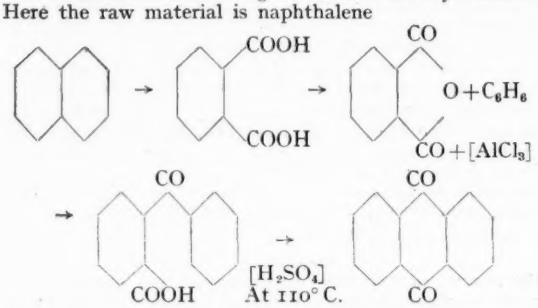
In order to avoid as far as possible the use of so expensive oxidising material as chromate, several processes have been evolved utilising other and cheaper oxygen carriers. Numerous patents have been taken out to protect processes in which the oxides of nitrogen function as oxidisers, one in particular using a solution of nitrogen peroxide in nitrobenzene. Another interesting process uses oxygen itself. In outline the process is as follows: 90 per cent. anthracene (1 cwt.) and acetic acid (5 to 10 cwt.), together with a little fuming nitric acid, are heated to 80° to 90° C. and oxygen forced in under pressure. It was claimed for this process that oxygen was absorbed until an almost quantitative yield of anthraquinone was obtained, but it has been found since that this ideal state is more nearly approached when the following modifications are incorporated. These comprise the addition of acetic anhydride to absorb the water formed and the use of sodium nitrite in the place of nitric acid.

The crude anthraquinone from the chromic oxidation process and from certain of the other processes has to undergo purification the extent of which depends largely on the purity of the original anthracene. The usual stages are as follows :— The crude material is digested with three times its weight of 82 per cent. sulphuric acid at 100° to 110° C. until a sample diluted with water gives an almost white precipitate. The solution is then diluted largely with water, when the sulphonated impurities remain in solution while anthraquinone, which is not attacked by sulphuric acid under these conditions, separates out and may be filtered off. Purification is also often effected by sublimation, for which, however, special plant is required. A capacious vessel provided with a lid and very wide side tube is heated by superheated steam or hot oil circulation to about 320° C., after having been charged with crude anthraquinone. The vapour of anthraquinone is carried from this vessel to the condensation apparatus by a current of steam superheated to 250° C. and the vapours are condensed by a powerful but finely divided water spray, which produces that state of subdivision which is highly desirable in anthraquinone. Produced in this way anthraquinone occurs as a yellowish powder usually of a purity of 97–98 per cent.

Synthetic Anthraquinone

The cost and difficulty of obtaining satisfactory anthraquinone for dyestuffs manufacture from anthracene, itself only with difficulty obtainable in a pure state, has recently led to extensive investigation of synthetic methods for the preparation of this substance. Of these the only satisfactory one is

that which involves the ring closure of *o*-benzoyl benzoic acid. Here the raw material is naphthalene



the vapour of which mixed with air is passed over a vanadium pentoxide catalyst mass maintained at a temperature between 400° and 500° C., when phthalic anhydride is formed in good yield, and can be purified by sublimation. Finely ground and freshly prepared aluminium chloride is mixed with benzene in a large lead-lined vessel fitted with the usual stirring devices and steam jacket, and a solution of phthalic anhydride in benzene is slowly run in. Stirring is maintained vigorously and the temperature rises to 35° C., at which point it is maintained for about an hour, after which the benzene is boiled until no further hydrogen chloride is evolved. The benzene is then removed by distillation, and also the water present, by the application of vacuum and steam heat; 98 per cent. sulphuric acid is then run in and the whole vigorously stirred at a temperature of 110° to 115° C., when condensation of the *o*-benzoyl benzoic acid takes place with the formation of anthraquinone, which may be obtained by dilution of the sulphuric acid solution, and sublimation, in a high state of purity.

Technical Progress in Dyestuffs in 1926

By L. J. Hooley

THE past year has marked an improvement in the position and prospects of the British Dyestuff Industry which future years will find difficult to parallel. Technical progress has been overshadowed by reorganisation and the year has seen an improvement in the industry's financial prestige which would have been sufficiently satisfactory as the result of five or ten years work, but which coming in one has been equally unexpected and gratifying.

Looking back on the difficulties and disappointments of the last five years, it is now possible to see these more clearly as being symptoms of general post-war weakness rather than of special faults in the industry itself, and in a time when capital reconstruction schemes are so frequent, the British Dyestuffs Corporation may be congratulated on beginning its own work of recovery so early. The satisfactory conclusion of this, following the difficult improvement in the two previous years, was recognised by the outside world as marking the beginning of a new stage. The agreement with Scottish Dyes was regarded as a further augury for success. After this some further extension of mutual interests, in the direction of an understanding with the heavy chemical industry, was regarded as likely in the future, but the formation of a combination on such broad lines as Imperial Chemical Industries was wholly unexpected, and particularly reassuring.

Although, as has been said, these larger questions have ranked in importance before directly technical advances, one of their most satisfactory features is the basis they offer for future research on more extensive lines and with a wider scope than was possible previously. During the last few years it has been evident that dyestuffs themselves are only one aspect of chemical progress; the special importance of dyestuffs however lies in the fact that they represent the organic side of the industry, and that advances in this direction can only be built on these as a foundation.

Turning now to chemical advances themselves, the year under review has shown a greater volume of British research than previous ones, and to this all the firms have contributed. In each of the divisions in which research is proceeding at the present time British advances are to be recorded, and there is no evidence of any falling behind now that results of post-war research are beginning to be felt.

New Colours

As showing one of the most obvious marks of progress during the year some of the most important of the new colours brought out may be given. Among acid colours there are the very bright Lissamine Fast Red B and Lissamine Green SF, along with Alizarine Sky Blue B and Alizarine Ultra Blue B, all due to the B.D.C. Along with these two latter must be placed Solway Light Blue R (S.D.L.) and Anthracene Brilliant Blue 3B (L.B.H.) Among acetyl silk colours there are Ionamine Blue B, Celatene Brilliant Red and Celatene Scarlet. Sulphur colours have been brought out by Hickson and Partners in Sulphur Brown M, by the B.D.C. in Thionol Direct Blue R, and by L. B. Holliday with Thionine Black BSP. As examples of chrome colours there are Solochrome Orange GR (B.D.C.) Diadem Chrome Black 10B and Monochrome Fast Orange PR (L.B.H.) To name only two examples of the vat colours there are Duranthrene Orange 4R and Caledon Blue 3RK. Two additions have been made to the Monolite pigment colours, namely Red D and Yellow 5G. In direct and basic colour there are Chlorazol Yellow 6G, valuable for its pure greenish yellow shades, Chlorazol Fast Brown 2RK and Victoria Blue B.

The importance which is attached to fastness in new dyestuffs has been stressed frequently in THE CHEMICAL AGE and it is interesting to note in this connection that the indigo, anthraquinone, benzanthrone and perylene derivatives account for more than one-third of last year's patents. The azo colours are responsible for another third, but fully half of these belong to the faster types such as the Naphthols and chrome and pyrazolone azo bodies. The remaining principal dyestuff groups, including the sulphide, indamine, thiazole and indophenol colours, the triphenylmethane, rhodamine, acridine, safranine and other basic colours amount all combined to less than a quarter of the whole, the basic colours outside the triarylmethanes being especially small. Acetyl silk claims quite a substantial number for itself, but these are of course spread over the various groups just mentioned.

Cellulose Acetate Dyes

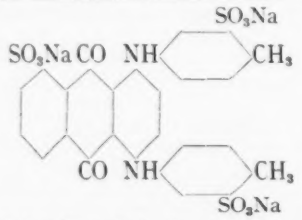
The credit for the major portion of the work on the dyeing of acetyl silk still belongs to this country and most of the manufacturers have added their quota during the last twelve months. The question of solubility, both in water and the silk, can still be felt to be the dominant idea behind most of the recent work. In extension of the Duranols and Celatenes we see in B.P. 248,858 and 244,267, both by B.D.C., W. H. Perkin, and C. Hollins examples of the more complex anthraquinone derivatives. These include the grey and blue dyestuffs obtained from diaminodihydroxy anthraquinones by condensing with anthraquinone urea derivatives and the brown dyestuffs from nitrated acetylamino anthraquinones. The blue hexamino dianthraquinonyl thio ether previously described in B.P. 231,206, is prepared by a slightly different method in B.P. 253,584 (S.D.L., J. Thomas, E. G. Beckett, and R. Tonkin). The use of carboxylic acid groups either directly attached to carbon or sulphur or indirectly through other groups is seen in B.P. 252,240, 252,646 (B.A.C., C. M. Barnard) and B.P. 246,840 (I.G.F.A.) and related to these are the glycol ether and glycerol ether groups of B.P. 245,785 (Sandoz). The stronger but generally less suitable sulphonic acid group is employed as its sulphamino derivatives, which have the advantage of the amino group at the end, in B.P. 257,654 (B.D.C., R. S. Horsfall, L. G. Henderson, J. A. R. Henderson, and J. Hill); D.R.P., 420,017 (B.A.S.F.); and in B.P. 243,738 (M.L.B.), all these three describing azo compounds. Free sulphonic acids, at one time regarded as quite unsuitable, but later used in special azo bodies by the B.D.C., are also made use of in B.P. 220,303 (S.C.I.B.), these again being azo derivatives. Even anthraquinone sulphonic acids are employed in U.S.P. 1,587,708 (Grasselli). In the products of this patent the acid groups are placed in the ortho position to amino groups. Solubilisation methods are extended in B.P. 242,711, 242,393, 244,143 (British Celanese, G. H. Ellis, etc.). Dyestuffs having affinity for acetyl silk are obtained by condensing amino or hydroxy bodies with dinitro chlor benzene sulphonic acid B.P. 244,936 (L. B. Holliday and A. Young).

Anthraquinone Series

The anthraquinone patents are so numerous that it is only dossible to touch very briefly on the main lines. The general tendency is seen to lie along the direction of improvements in technique and elaboration of alternative methods of producing known compounds. This is the natural result of the entry of a large number of manufacturers into this group during the last half dozen years or so.

The extraction of anthracene from coal tar in a special plant is given in B.P. 255,429. The purification of the crude anthraquinone produced in the oxidation of anthracene, either by extracting the impurities with hot alkali or by dissolving out the anthraquinone as a soluble alkali salt of anthranol after reduction, leaving the impurities behind, are given in U.S.P. 1,591,712 and 1,583,299, respectively (Nat. Anil. Co.). The fundamentally important anthraquinone beta sulphonic acid is purified through its ammonium salt by the Newport Co. U.S.P. 1,584,372. Improvements in the production of chlor-anthraquinones, nitro chlor anthraquinones, etc., from substituted benzoylbenzoic acids are made by S.D.L. and J. Thomas in B.P. 248,411 and 243,505, while economies in the use of alkali in the caustic fusion of anthraquinone 2 chlor to alizarine are effected in B.P. 246,529 (S.D.L., J. Thomas, H. W. Hereward).

In B.P. 245,584 (H. Dodd, W. C. Sprent, and United Alk. Co.) the synthetic production of quinizarin from *o*-chlor phenol instead of the usual *p*-chlor phenol is claimed, and in B.P. 256,068 the same authors obtain chlor hydroxy anthraquinones free from hydroxyanthraquinones, by the same process as used in the last patent for quinizarin, but with the omission of the boric acid there employed. They form the usual colour bases, which can be used for sulphonation to wool dyes, by condensing the quinizarin, without previous reduction, with one or two molecules of *p*-chlor aniline instead of the more usual *p*-toluidine B.P. 248,874. Analogous to these condensation products of quinizarin with two molecules of *p*-toluidine are the products in U.S.P. 1,580,265 and in B.P. 244,450, the former having the constitution shown below :—



and the latter being the sulphonic acid of the 5.8 dihydroxy derivative of the base of this. In D.R.P. App. F. 59,272 amino hydroxy anthraquinone derivatives are reduced to the corresponding leuco *p*-dihydroxy bodies. Further examples of the wool dyestuffs obtained by the sulphonation of dianthraquinonylamines are found in U.S.P. 1,564,091 (Grasselli). Somewhat similar products to the arylamino anthraquinones but distinct in being formed from secondary instead of primary aromatic amines are made from halogen anthraquinones and carbazole in D.R.P. 430,884. *N*-methyl-ω-sulphonic acid derivatives of 1.4 and 1.8-diamino anthraquinones are produced in B.P. 252,922 by an improvement of the previously known process (B.D.C., W. H. Perkin, A. W. Fyfe, and M. Mendoza).

The Du Pont Co. describes an alcoholic alkali melt for the fusion of beta aminoanthraquinone to indanthrene in U.S.P. 1,580,700. The indanthrene derivative previously described by the S.C.I.B. as obtained from anthraquinone 2 amino 3 carboxylic acid, is in B.P. 249,099 obtained by an alternative method using anthraquinone 1 brom 2 amino 3 carboxylic acid and condensing this in nitrobenzene solution with sodium acetate and a copper catalyst. This product dyes greenish shades of blue. B.D.C., J. Baddiley, and A. Shepherdson describe the purification of crude flavanthrone in B.P. 249,993.

The synthesis of 1.1′ dianthraquinone 2.2′ dialdehyde, the intermediate product for pyranthrone, is given in B.P. 253,386 (B.A.S.F.), the process consisting in treating diazotised anthraquinone-1-amino-2-aldehyde with cuprous halides. Pyranthrone is brominated in U.S.P. 1,581,111 (Newport Co.).

Among the acylamino anthraquinones and the closely related ureas we have the production of anthraquinones mono-oxamino acids from diamino bodies. B.P. 250,883 (B.D.C., H. M. Bunbury, and R. Robinson). These are condensed with halogen anthraquinones to produce formylamino dianthraquinonylamines in B.P. 248,866, the oxalyl group losing carbon dioxide and going over to the corresponding formyl one in the process. Monobenzoyl derivatives of diamino anthraquinones are obtained by benzoylating with benzoic anhydride B.P. 255,630 (B.D.C., W. H. Perkin, and H. M. Bunbury). Anthraquinonoylamino anthraquinones are described by Rollet in *Monatshefte* (1926, 131).

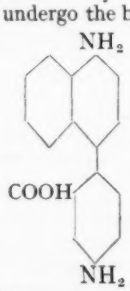
Anthraquinone thiazoles are nitrated, reduced and benzoylated in D.R.P. App. B. 117,804 the products being red, brown, and yellow vat dyestuffs.

Perylene

In the perylene derivatives exclusive of those obtained via benzanthrone, this year has shown rather fewer patents than last, and the ones that have appeared have been confined to methods of production, halogenation, etc., and also to the production of products of the dibenzanthrone type by condensing perylene with two molecules of an acyl derivative and ring closing. For this purpose either perylene or preferably halogen perylenes are treated with aromatic acids, their anhydrides or chlorides. In F.P. 589,643 (C.N.M.C. and Pereira) both stages of the condensation are carried out in one using aluminium chloride (see also F.P. 591,791, 591,271).

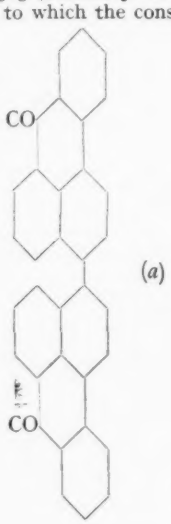
Benzanthrone

The patents in the benzanthrone section are of great interest and it is unfortunately only possible to allude to them here in the briefest possible manner. A new synthesis of benzanthrone derivatives from naphthalene azobenzene-*m*-carboxylic acid is described in B.P. 254,021, U.S.P. 1,588,376, 1,565,229 (Cassella). The azo body is reduced to the hydrazo, and this then caused to undergo the benzidine rearrangement:

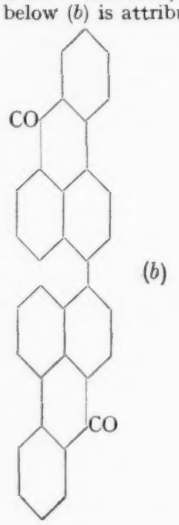


The ring is then closed by means of chlor sulphonic acid to give the diamino benzanthrone.

The recently discovered dibenzanthronyl to which the probable constitution shown below (*a*) has been assigned has been followed by two further ones: one of these is obtained by oxidising benzanthrone with manganese dioxide and sulphuric acid. This dibenzanthronyl on further treatment with alcohol and potash gives dibenzanthrone in very pure form, B.P. 251,313 (S.D.L., J. Thomas, and R. F. Thomson). The third one to which the constitution below (*b*) is attributed is



(*a*)



(*b*)

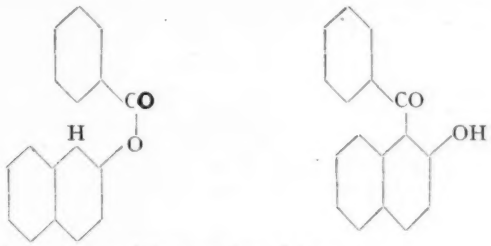
given in B.P. 255,277 (B.A.S.F.). This on further fusion gives isodibenzanthrone.

Along with the dibenzanthronyl described in B.P. 251,313 a hydroxy benzanthrone is obtained which can be methylated and this then condensed to give a methoxy dibenzanthrone.

A considerable number of sulphur compounds of the benzanthrones have recently been protected, especially benzanthrone mercaptans, thioethers, sulphides, and disulphides. The majority of these are readily obtained, and they are used as intermediates for the production of more complicated benzanthrone derivatives.

Some further condensation products of the pyrene quinone type have been produced from benzanthrone by condensing mono or dicarboxylic acids, acid chlorides, etc., with benzanthrone by the aid of aluminium chloride. D.R.P. App. F. 56,699, U.S.P. 1,582,475. The products are similar to the previous ones described in giving yellow to orange vat dyes.

Hydroxy benzanthrones still attract attention, *e.g.*, D.R.P. Appln. B. 116,080, and a new interesting method of synthesis for these is from β-naphthyl aromatic acid esters which on treatment with condensing agents transpose to give the derivatives shown:



and then only need further ring closing.

Wool Vat Dyes

These vat colours of the arylido-quinone, thiazine, and to a certain extent the indigo class, to which more extended reference was made in last year's annual summary, show further examples in U.S.P. 1,588,384 (Grasselli).

Phenazine derivatives are given in F. P. 593,117 and further methods of forming soluble vatted preparations of the dyestuffs in D.R.P. App. F. 56,947.

(To be concluded.)

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

THE dyestuff market in December showed an improvement large enough to be noticeable, but not large enough to relieve the generally unsatisfactory position.

Reviewing the year and considering its enormous difficulties, it must be said that business in dyestuffs has kept up remarkably well, and although it is doubtful whether any profits have been made, yet it seems certain that no serious losses have been incurred.

It is customary at this time of the year to talk optimistically of the future. Even on the lowest basis, namely, that it seems impossible to believe that conditions could be as bad in 1927 as they were in 1926, there is reason to be optimistic so far as dyestuffs are concerned. In Lancashire the state of the market is largely bound up with that of the cotton trade, and the latter is still in a precarious condition. During the month longer working hours in the spinning section have been resumed, not because of any increase in bulk of business, but rather because of the refusal of a number of spinners to conform with the policy of short time. A further meeting of the American Yarn Association, at which Lord Colwyn is to preside and Mr. Keynes to speak, gives promise of some scheme for radical reconstruction which will be generally acceptable, and if this could be combined with some penalty for those who refuse to accept a general scheme, then there is every reason to be optimistic. The banks are deeply involved, and possibly they could bring such pressure to bear on the refusers that no stipulated penalty is necessary.

The I.C.I. shares have been dealt in during the month, and have had a very favourable reception from the investor. Provided that there is a general improvement in trade, the I.C.I. should be one of the first companies to benefit, and the favourable attitude of the investor may be taken as representative of the general view that 1927 is going to be a good trading year.

Yorkshire

Conspicuity rendered to British made benzol by its absence since May last is gradually being effaced as the coke ovens progressively become operative and the first tardy deliveries of that most essential "starting point" product made. Contemporaneously quotations for Continental benzene indicate a big fall in price. The scarcity was most keenly felt by intermediate makers towards the end of October and during the greater part of November when Continental supplies were short, shipment difficult, and freights high. Execution of orders in hand for their products lagged until the termination of the coal stoppage diminished some of the difficulties and cargoes of the foreign product came in more freely. December turnovers have been much inflated by deliveries of intermediates much overdue. It is to be hoped that consumers of intermediates and allied products will appreciate the efforts of makers to maintain supplies, even at financial loss, during the whole unhappy period.

British makers quote benzol, crude 65's, when available, at about 1s. 4d. per gallon ex works in tank wagons. Pure toluene and pure xylene are somewhat scarce and free supplies not expected before early February. A movement towards normal prices for some intermediates has been evident, others are still scarce and prices high; aniline oil and salt are quoted at about 7d. per lb., the pre-stoppage figure, while carbolic acid crystals, pre-stoppage price 4¾d., are now quoted at 7d. per lb.

With higher prices for Continental sodium sulphide the home makers are enjoying an increased share of the home trade. Sodium hypochlorite, 14 per cent. available chlorine, is down to about £10 10s. per ton delivered and about £10 5s. for contract over 1927.

Colour, design, and briskness of demand for spring appear to be the leading features of the Huddersfield worsted piece trade. More machinery is being brought into employment for woollens. The year closed with a wave of optimism with regard to trade in the New Year in both sections. Confidence is returning in the Heavy Woollen District, too; increased activity in some factories has been observed, and there is a steady decline in unemployment. The stabilisation of the Belgian currency has, it is said, given British cloth manufacturers a better chance in the Belgian market, and it is expected that stabilisation in France will have a similar effect in that country; in their home markets, also, the British manufacturers expect to gain. Halifax worsted piece goods prospects for 1927 are viewed with some hopefulness.

The Christmas holiday period almost general throughout Yorkshire extended from Friday night to Wednesday morning, when dyestuff and other chemical works at once became active again. The ringing out of the Old Year was heard without regret, and those of us who allowed minds to run on such thoughts felt our industry to be worthy of congratulation on the manner in which it had borne its 1926 burden, and that 1927 would not be without such difficulties as only the same spirit of determination could surmount.

Midlands

The improvement in the hosiery trade experienced during November and early December was not maintained, the second half of December being distinctly quiet. The new year opened with everyone in an optimistic mood. It is all to the good to find manufacturers so cheerful, but why optimists have taken the field so completely seems difficult to judge, unless it is that two of their principal raw materials, cotton

and wool, are cheap. Everyone is confident of a bumper year. We trust their hopes will be realised.

It is now certain that light shades will again be in vogue in the coming spring and summer. At the moment the woollen section is fairly busy. Some spinners are working full time and there is a reasonably good demand for woollen hose and half hose. Knitted fabric is also in request.

Cotton.—Sewing and splicing cottons are fairly brisk. The demand for knitted fabric is maintained. Cotton hose are very slack owing to foreign competition. Cotton lace curtains are steady.

Artificial Silk.—Panel hose are generally quiet, but a few export orders have been booked and manufacturers are expecting a good spring trade. Artificial silk fabric is rather slow, but fancy fabrics composed of art silk and other fibres are a brighter spot.

Natural Silk Hose.—This trade is growing steadily.

Leather.—There is a good inquiry for chrome upper leathers in various brown shades in calf and goat, and a good deal of interest in light shades of glazed kid for ladies' footwear. There is a steady sale for glove and motor clothing leathers. Fancy leathers for upholstery, book-binding, and bag and purse trade are not so brisk as before Christmas.

Prices for dyestuffs are now steady. Here and there prices are shaded, but as dyes are no dearer than any other important chemical products compared with pre-war prices we do not look for any important reductions.

Scotland

December was a quiet month in keeping with the difficult year which it has brought to a close. Business in the cotton yarn and piece goods sections as well as in bleaching and printing was patchy, with the wool dyers better off. Including both the Christmas season and the New Year holidays December is not a month to which too much importance can be attached. The holiday stoppages have not been much longer than normally and in the Border district have been restricted this year to two days. This is the district which, as will have been evident from previous reports, is the one that can look back on the past twelve months with the most satisfaction, for the woollen trade has certainly had nothing to complain of during the latter half of the year. The tweed and related sections have been the most satisfactory, with the hosiery not quite so good. The West and Glasgow districts have had to be content with intermittent orders, while the linen trade has experienced an exceptionally difficult time.

With the end of the year, especially in the cases of those firms who make up their annual reports at this time, it will now be possible to realise more fully the extent of the year's damage, and reports are awaited with great interest. There is a feeling in many cases that even where it has been possible to keep going right through the stoppage, the financial results will make sufficiently serious reading. Under these circumstances the prospects for the coming year are being examined with more than usual interest.

As regards industry generally there is a determined effort to be optimistic about 1927, even in some cases to the extent of foreseeing something of the trade revival which has been so eagerly awaited during the last two or three years. Perhaps the feeling that so much was accomplished during 1926, in spite of its terrible drawback, has engendered the confidence that the expenditure of the same effort in what promises to be a more normal year cannot help but bring proportionately better results. Apart from this and evidence of greater sanity generally, it is difficult to see any substantial basis for prosperity. The after effects of the coal strike have still to be counteracted before any other leeway can be made up. The cotton trade is, of course, assured of plentiful supplies for two years, and the removal of short time may prove another advantage; but opinion is sharply divided on this point. There is no apprehension as regards dyestuffs, and any price movements will, following the course of the last few years, be inevitably in a downward direction. Coal has now got back to practically its old price level, and the straightened circumstances in which both the large and small dyeing and finishing firms find themselves are undoubtedly acting as an incentive to the greatest possible internal efficiency.

Even if the grounds for optimism are vague, its presence is the best augury for success that can be hoped for under present circumstances.

Dyestuffs "Who's Who": (9.)—Mr. E. Arthur Bearder, M.Sc., F.I.C.

DURING the recent years of strenuous endeavour to build up a national dyestuffs industry, few people have been more closely identified with the dyestuffs problems of Great Britain than has Mr. E. A. Bearder, Dyestuffs Adviser to the Association of British Chemical Manufacturers and Technical Adviser to the Dyestuffs Advisory Licensing Committee of the Board of Trade, a familiar figure to users as well as to manufacturers of dyestuffs.

MR. E. ARTHUR BEARDER.

A native of Bradford in Yorkshire, Mr. Bearder graduated at the University of Leeds with 1st class honours in Colour Chemistry and was awarded the Le Blanc Medal for special distinction in that subject. He took the University Diploma in Dyeing, and won the Clothworkers' Research Scholarship.

After a period of post-graduate research under Green and Perkin, Mr. Bearder was given an appointment as research chemist with Levinstein, Ltd., at Blackley, but, deciding to devote his attention to the application of dyestuffs to textiles, he joined the Swiss Society of Chemical Industry in Basle, where he laid the foundations of the comprehensive knowledge and experience—subsequently developed in his capacity of technical expert attached to the Clayton Aniline Co.'s factory—which enable him so successfully to fill the unique position which he holds to-day.

In the early stages of the war Mr. Bearder served on the committee formed under the auspices of the Society of Dyers and Colourists to consider ways and means of securing an adequate supply of dyestuffs for Britain's textile and other industries. When the Dyestuffs (Import Regulation) Act came into operation in 1920, Mr. Bearder was appointed by the Association of British Chemical Manufacturers to represent the dyemakers' interests as Technical Adviser to the Dyestuffs Advisory Licensing Committee. He is also Secretary of the Dyestuffs Group of the Association of British Chemical Manufacturers; Joint Chairman of the Joint Technical Committee of the latter and of the Colour Users' Association; a member of the Revision Committee of the Colour Index of the Society of Dyers and Colourists. He is a Master of Science of Leeds University and a Fellow of the Institute of Chemistry.

In tinctorial chemical circles Mr. Bearder is known as one of the authors of the section on "Dyestuffs" in the Annual Reports of the Journal of the Society of Chemical Industry, and as the writer of the section on "Coal-tar Colours" in *Chemistry in the Twentieth Century*.

These are his technical qualifications, and if they stood alone they would be sufficient to merit comment, although they would not account for the position he has made for himself. He couples with them a sound judgment on technical matters, and his steady impartiality and readiness to assist maker or user has earned for him the respect and thanks of those with whom he has had to work in circumstances which have not always been easy.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers andusers of dyestuffs, and contributions will be welcomed.*

New Colours

THE vogue for pale and bright shades in wool materials has revealed a weakness in colours which have hitherto been considered to be of sufficient fastness. The possibility of using vat colours, which have already obtained a world-wide reputation when used on cotton goods, has therefore, suggested itself. In consequence, the British Dyestuffs Corporation have prepared a very complete pattern book showing a range of thirty-six vat colours on wool, with tables showing the various strengths of the dye baths. These are the well-known Duranthrene, Caledon, and Durindone colours. The effects are notable for their softness and delicacy. Particulars are given in each case of the dyeing process.

Hickson and Partners, Ltd., Castleford, Yorks, have added "Vidal Victory Black B Extra" to their already extensive range of blacks. The pattern card shows four samples, with the composition of the baths used.

The Du Pont Co. announce two new products, Sulfanthrene Pink BG Paste and Pontamine Diazo Brown R; the National Aniline and Chemical Co. three new colours, National Superchrome Black T, National Sulphur Brown R, and Alizarol Brown RH Conc.; and the Newport Chemical Works, Inc., three new colours, Newport Fast Acid Blue SR, Newport Acid Anthraquinone Blue B, and Newport Fast Chrome Brown EB.

The "Boom"

OUR market reports indicate that the optimism expressed with the opening of the New Year has not yet been realised. From the Midlands, from Yorkshire, from Scotland the story is much the same. Orders, we are told, have been disappointing and buyers hesitant; no improvement is visible yet and judgment is in the meantime reserved. This feeling, it is said, characterises not only the dyestuffs but the chemical market generally. From Yorkshire it is reported that some ruthless price cutting by Yorkshire dyestuffs makers has occurred. From the Midlands the reports so far are not particularly encouraging. The simple explanation is that the industries which absorb chemicals and dyestuffs have not had time to get going again, though the signs are better, and the improvement in the dyestuffs trade will come with the improvement in industry generally. The most hopeful news comes from Lancashire

Fastness Standardisation

THE Committee, under the chairmanship of Mr. Scholefield, which is to investigate the problem of the standardisation of the fastness properties of dyestuffs has undoubtedly a huge task, but one that can no longer be neglected by a nation so vitally interested in textiles as is our own. The public spirit shown by the Society of Dyers and Colourists is highly commendable. On the general subject of the fastness of dyestuffs the support of public opinion would appear to be worth cultivation. That it is possible to purchase coloured materials with a guarantee of fastness when, in fact, the fastness of the colours used warrants no such guarantee would seem to suggest a lack of understanding on the part of the public, and a danger that "fastness" may come to be looked upon as a mere advertising catch word. The I.G. has embarked upon the enterprise of backing a series of continental shops in which all goods displayed are dyed with the fastest colours and all sold under a guarantee which means something. That a dyestuff firm should become a retail trader in textiles is remarkable, but reports are to the effect that the public is responding with a rapidly growing demand for materials guaranteed by the I.G.

Dyestuff Licences in January

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during January, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee. The total number of applications received during the month was 509, of which 453 were from merchants or importers. To these should be added 62 cases outstanding on December 31, making a total for the month of 571. These were dealt with as follows:—Granted, 496 (of which 435 were dealt with within seven days of receipt); referred to British makers of similar products, 58 (of which 47 were dealt with within seven days of receipt); referred to Reparation supplies available, 6 (all dealt with within two days of receipt); outstanding on January 31, 1927, 11. Of the total of 571 applications received, 488 or 85 per cent. were dealt with within seven days of receipt.

False Dye Labels

FALSIFICATION of dye labels and packages has apparently become so common in Japan that, according to a statement by the U.S.A. Department of Commerce, all manufacturers and merchants must market their goods under labels unmistakably descriptive of their origin, and dye producers must pack their colours in such a way as to prevent restoration to their original shape or appearance. Merchants are to be prosecuted if they sell Japanese dyes under foreign labels, or sell as foreign colours Japanese dyes mixed with the former. The Japanese Government's purpose in seeking to prevent falsification of labels is not alone to protect the consumer, who may be willing to pay a higher price for imported colours, but to establish the excellence of certain Japanese dyes in the minds of Japanese purchasers. The Government apparently considers that some, if not all, of the colours produced by the Japan Dyestuff Corporation under Government subsidy are equal to American or German dyes in quality, and wishes to combat the impression still prevalent among some consumers that all foreign dyes are necessarily superior to the home product.

Japanese Dyestuffs Market

THE market for foreign dyes in Japan, according to an American consular report from Tokio, is almost non-existent, representatives of foreign concerns reporting the worst business for years. Last year the period for the subsidy by the Japanese Government to the Japan Dyestuffs Manufacturing Co., Ltd., ended and the company was not in a position to carry on its business without this outside support, but, as the Government has undertaken to assist the company directly or indirectly, it was decided to continue the business. Afer revision of the import tariff, the company's manufactures have risen in price by

20 to 50 per cent. In August, 1926, an agreement as to the sale of the manufactures was reached between the company and wholesale merchants, and the company is now working at its full capacity. It is said that for the six months ended September, 1926, better results were obtained than for the preceding six months.

Concerning the subsidy which the Japanese Government has agreed to pay to Japanese manufacturers for some twenty dyes which the Government has designated, it is understood that one of the chief dye concerns, the Nippon Senryo Kaisha, is now turning out seven of the twenty. In March the company produced Kinolin Yellow for the first time, and since then has received subsidy grants on the following seven :

	Kilos Produced	Grant Yen
Kinolin Yellow	6,500	60,799
Saffranin T	3,300	33,600
Naphthol AS	4,000	56,133
Direct Black BH	5,000	18,942
Direct Violet	1,300	3,564
Chrome Black F	11,000	50,592
Rhodamine G	150	1,487

Of these, Kinolin Yellow is said to be the most satisfactory and may be able to pay its own way after the next six months, at the end of which the grant will be withdrawn. Naphthol AS, Direct Black BH, Direct Violet and Rhodamine G, it is said, can be produced commercially in the following six months under half the amount granted at present. The subsidy fund is 800,000 yen, and is to cover expenditures over a period of six years. Full production of the dyes is now expected to be secured in three years instead of five, as was fixed when the fund was established. In the event of full production being found possible in three years, the surplus of the fund will be utilised in paying grants on five or six other kinds of dyes, to be designated by the Japanese Government.

American Fastness Tests

THIS question of colour fastness has for some time been receiving attention in America, and at a recent meeting of the joint committee of the Textile Institute a report was adopted, outlining a general scheme of standards for fastness. The general conclusion was that universal standards were impracticable, but that certain general standards could be established which would serve as a guide. The first point decided was to limit the scheme to fastness to washing and fastness to light, these being the important points from the public point of view. It was suggested that three classes of fastness to light and three classes of fastness to washing should be adopted and recommended to the trade. These are class A : The best of the " fast " colours, that is, those capable of standing unusual treatment ; Class B : good colours that will stand ordinary light exposure and reasonable laundry treatment ; Class C : commercial colours of no particular fastness.

Fastness to Washing

IN the classes for fastness to washing, the following terms were suggested :—

Class A.—Cotton fabrics that show practically no alteration in colour and practically no staining of white cotton in the following test :

Test for Solid Colour Fabrics.—The fabric to be tested, to which has been sewn a smaller piece of white cotton cloth, is immersed for thirty minutes in 100 times its weight of a boiling solution containing 0·5 per cent. soap and 0·2 per cent. anhydrous sodium carbonate. It is then removed, rinsed thoroughly in tepid water and dried in a current of air at ordinary temperature. The sample is then moistened with water and pressed dry with a hot iron whose temperature is such that the iron will not brown the white material and will not be wetted by drops of water.

Test for Fabrics Having Coloured Designs or Stripes on a White Ground.—The test given for solid colour fabrics is applied with the following addition : After rinsing, the sample is immersed in a sodium hypochloride solution containing 0·01 per cent. of available chlorine for ten minutes at 160° F. It is then removed, rinsed in tepid water, and immersed in a solution containing 0·05 per cent. acetic acid for ten minutes at 105° F. Finally, it is rinsed thoroughly in tepid water, dried in a current of air at ordinary temperature, moistened and ironed as described above.

Class B.—Cotton fabrics which show practically no alteration in colour and practically no staining of white cotton in the following test :

Test for Solid Colour Fabrics and for Fabrics Having Colour Designs or Stripes on White Ground.—This test is identical with that given under Class A for solid colour fabrics, except that the temperature of the wash solution is to be 120° F.

Class C.—Cotton fabrics which do not meet the requirements of Class A or B.

Fastness to Light

THE following is the suggested scheme under this head :—

Class A.—Cotton fabrics which show practically no alteration in colour when exposed to daylight under glass under the conditions prescribed below for the equivalent of thirty consecutive days between May 1 and August 1.

All samples are to be exposed at an angle of 45 degrees facing due south, in a cabinet covered with a good grade of window glass approximately one-eighth of an inch thick, and open at the sides in such a way as to allow free circulation of air over the samples. The distance between the samples and the glass should be approximately one-half inch. A portion of each sample is to be protected from the light by opaque material, for instance, black cardboard.

Class B.—Cotton fabrics that show practically no alteration in colour when exposed under the conditions prescribed above for the equivalent of five consecutive days between May 1 and August 1.

Class C.—Cotton fabrics that do not meet the requirements of Class A or B.

It is proposed where these suggestions are adopted, that a form of guarantee should be attached to the fabric, indicating the class to which it belongs as regards both light and washing.

Colour-mad Paris

MR. LEDYARD TOWLE of the Duco Colour Advisory Service, in some notes on the Automobile Salon, describes Paris as " colour-mad." " At the Grand Palais, where the motor car creations of the great manufacturers stand in rows like the King's guard upon parade, there are glints of burnt orange, and the dull rich warmth of maroons taking their place in the colour harmonies of a whole and giving forth a note like the muffled sound of a convent bell. Never before such a spectacle. No longer the dead monotony of sombre hues. Here is beauty, and life and soothing satisfactions for the eye, studied from Nature herself and deliciously reproduced in endless and ever changing subtleties. Town cars of jade. Roadsters of café-au-lait and crimson. Sedans of orchid and sable. The colours of the lagoons in Venice at midday. The myriad golden browns and copper-reds and brown-yellows of the autumn leaves. Greens of the spring brookside and rich scarlets that vision poppies and sunsets. Outside along the Champs Elysées the changing kaleidoscope thrills with its never-ending stream of harmonies." At the Opera the brilliant hues worn by the crowd were " like a gorgeous Spanish shawl." " The age of colour," he declares truly, " is indeed here. Whatever our nationality, our estate, or time of life, we can dare to express our colour individuality, each in his own way ; in our homes, our furniture, our automobiles and ourselves."

Dr. Armstrong's Address

THERE was an unusually large attendance at the Royal Society of Arts on Wednesday evening to hear Dr. E. F. Armstrong's address on " The Romance of the Organic Chemical Industry." The address contained frequent references to the dyestuffs industry, and some very beautiful examples of the dyer's art were exhibited. Mr. Chaston Chapman presided and the vote of thanks to the lecturer was proposed by Professor H. E. Armstrong and seconded by Mr. W. J. U. Woolcock.

Special Processes for the Dyeing and After-Treating of Textiles

By A. J. Hall, B.Sc., F.I.C., F.T.I.

Those responsible for rendering textile materials pleasing, attractive and saleable must be wide awake in these days. To a large extent, standard methods are a thing of the past. Public taste in clothes and fabrics was never more fickle than it is to-day. This, coupled with the introduction of new textile fibres, new dyes, and new bleaching and finishing substances, renders it necessary for modern dyers and finishers to keep abreast of scientific discovery and its effect on their particular branch of industry. In the following article will be found reference to several recently introduced methods for dyeing and otherwise treating yarns and fabrics.

For many years it has been difficult to dye very fast shades on natural silk owing to a scarcity of suitable dyes. Silk dyers have to a large extent fought shy of vat and sulphur dyes, and in consequence no range of shades on silk having a fastness equal to that of vat dyes on cotton has been produced. Since the war, however, interest in fabrics dyed in guaranteed shades has increased and silk materials have shared this interest. In the past a few silk dyers have used vat dyes, but within recent years much more interest has been taken in their application to silk, so that it is safe to predict that it will not be long before they are used to a much greater extent than formerly. There is a further reason why vat dyes should be used for natural silk. The application of vat dyes is more expensive than other dyes. Cotton is a cheap textile fibre, and this extra cost looms up largely in the eyes of the dyer. On the other hand, natural silk is one of the most expensive fibres, so that it can carry high dyeing charges more easily; and, generally speaking, the more valuable a garment or fabric the greater the reason for refusing to allow costs to interfere with its proper colouring and ornamentation.

Alkalis and the Vat Dyeing of Silk

In dyeing natural silk with vat dyes it is not necessary to take special precautions to reduce the alkalinity of the dye liquor, although it is well known that this fibre is affected by caustic alkalis. Vat dyes may be roughly classified into two groups—those which cannot be advantageously dyed from a liquor containing less than 0·15 per cent. of caustic soda and those which require four times this quantity of alkali. Further, such dyes may be divided into those types which are dyed from cold, warm or hot dye liquors. Many of those dyes which require the maximum quantity of caustic alkali also need a hot dye liquor (50° to 60° C.), yet in spite of these apparently severe conditions such dyes may be applied to natural silk in the usual manner. Of course, in dyeing natural silk with vat dyes, unnecessary exposure of the silk to the action of the alkaline dye liquor should be avoided, and after dyeing, souring should be effected as soon as possible; under no circumstances should silk containing caustic alkali be allowed to dry, otherwise it will become harsh to handle and suffer much loss of strength. In the great majority of cases it is sufficient to degum the silk before dyeing, bleaching being necessary only for the production of very pale bright shades.

Natural silk may be dyed "in the gum" with vat dyes when desirable. It is well known that silk in the gum weaves better than after degumming. Vat dyes on silk in the gum are fast to degumming processes. Hence vat dyes are particularly useful for dyeing raw silk which must not be degummed until a later stage of manufacture. It is not generally appreciated that natural silk in cotton fabrics will withstand the process of mercerisation. Since vat dyes generally withstand this process, silk effect threads dyed with vat dyes are very suitable for use in cotton fabrics requiring a mercerised finish.

Naphthol AS Dyes on Silk

Naphthol AS dyes are very fast to most influences; they are perhaps the most promising rivals of vat dyes, though they are not suitable for application to small quantities of material. Recently (Lint; *Textilber.*, 1927, 67) the possibility of applying these dyes to natural silk has been explored. It will be remembered that Naphthol AS dyes are applied by first impregnating the textile material with a suitable naphthol of the Naphthol AS type (these are all derivatives of beta-hydroxy naphthoic acid, and about ten such naphthols are now available) and then treating the material with a solution containing a suitable diazotised base (amine), whereby the shade is developed. Hitherto, these dyes have not been applied to natural silk, one difficulty being that diazo compounds have the power to combine with the silk fibre itself, thereby producing brownish colorations which obscure the pure colour tone of the true Naphthol AS dye. Lint has shown that Naphthol AS dyes may be applied to natural silk, avoiding this defect, provided that the treatment with the diazo solution is maintained slightly acidic (not neutral as is usual in the case of dyeing cotton) during the process of development. For this purpose a slight excess of acetic or formic acid is added to the diazo solution.

It is not always safe to assume that a dye fast on cotton will be equally fast when applied to natural silk, but in this case Lint states that the fastness of Naphthol AS dyes on the latter fibre is equal to or faster than corresponding shades on cotton. For silk materials it thus becomes possible to produce exceptionally fast shades by means of Naphthol AS dyes, which have the advantage of being cheaper than vat dyes.

In dyeing natural silk with Naphthol AS dyes it is advantageous to add a protective colloid such as Protectol to the caustic alkaline prepare solution used for impregnating the silk with the naphthol. The addition of this substance may be omitted, but on the other hand it promotes even dyeing, while assisting the preservation of the high qualities of the silk. If desirable, degumming and impregnation with the naphthol may be carried out in the same liquor. Further, degumming may be carried out after dyeing, the fastness of the Naphthol AS dyes being easily sufficient to withstand this treatment. It is possible to dye Naphthol AS dyes on tin weighted silk.

A recent patent (E.P. 262,537) also foreshadows the application of Naphthol AS dyes to wool by a special process. In this modified method the wool is impregnated with a mixture containing the naphthol, base, and sodium nitrite, and then treated with an acid solution. Alternatively the wool is impregnated with the naphthol and sodium nitrite only, and then treated with an acid solution of the base. In either case, diazotisation of the base, coupling of the diazotised base with the naphthol, and absorption of the resulting dye by the wool substance occur simultaneously. In this manner very fast dyeings become possible.

Black Dyeing of Cellulose Acetate Silk

Two methods have been recently added to those already available for dyeing cellulose acetate silk in black shades. Hitherto it has been possible to obtain such shades by means of mordant and developed dyes. Thus a very handsome shade is produced when cellulose acetate silk is dyed with Logwood and then after-chromed at a moderate temperature (about 60° C.), or when the silk is dyed with a suitable solubilised dye of the S.R.A. type and afterwards coupled with a naphthol, beta-hydroxy-naphthoic acid being particularly suitable. The first black is not very fast to light and not fast to acids, while the production of the second black is somewhat uneconomical as regards labour and time. Celatene Black is the only direct dyeing black for cellulose acetate silk, but it is costly because of the large amount required for a deep shade. Hence the value of the two recent methods for producing an oxidation black on this type of silk.

When cellulose acetate silk is dyed in the usual manner with Aniline Black it fails to develop anything more than a yellowish green shade. Yet Aniline Black has such an excellent all-round fastness and is so largely applied to cotton materials that a means for dyeing cotton materials containing cellulose acetate silk black by means of the usual Aniline Black process is highly desirable. In E.P. 258,699 protection is claimed for the discovery that cellulose acetate silk readily absorbs 2 : 4-diaminodiphenylamine and that oxidation by treatment with an acid solution of sodium chlorate containing

copper sulphate as a catalyst results in the production of a very fast black shade. This new amine may be used in admixture with aniline and other commoner bases. It is further found that 2 : 4-diaminodiphenylamine is oxidised very much more readily than aniline, and it is possible to dye cellulose acetate silk continuously by a method closely resembling that used for Aniline Black. In this case the cellulose acetate silk material is padded with a mixture containing 2 : 4-diaminodiphenylamine with or without aniline or *o*-toluidine, sodium chlorate, hydrochloric acid with or without acetic acid, and copper sulphate or chloride, and steamed for development of the full black shade. In E.P. 255,962 use is similarly made of para-aminodiphenylamine, an amine which before the war was used instead of aniline for dyeing cotton materials. Since both these amines yield black shades on cotton, the dyeing of union fabrics consisting of cellulose acetate silk and cotton may thus be completed in one operation.

Although the printing of cellulose acetate silk materials is comparatively easy, some difficulty has been experienced in obtaining satisfactory discharges, probably owing to the waterproof nature of this type of silk. For instance, when dyed cellulose acetate silk is printed with a discharge paste whose essential constituent is sodium sulphoxylate formaldehyde or sodium hydrosulphite, and then steamed, the penetration of the reducing paste is insufficient to produce a clear white discharge under the usual conditions. In order to overcome this difficulty use is now being made of an early observation (E.P. 158,340) that solutions of ammonium sulphocyanide have a swelling action on cellulose acetate silk. When this substance is added to the discharge paste slight swelling of the silk occurs during steaming and this allows a clear discharge to be obtained. The process is protected by E.P. 262,254.

Synthetic Resins for Finishing Cotton Fabrics

In the finishing of cotton fabrics, increased interest is being attached to the possibility of using synthetic resins. At the moment that synthetic resin which appears most useful is the condensation product of urea and formaldehyde. Resins obtained from phenols and formaldehyde are usually dark coloured and therefore unsuitable, while insoluble products obtained from casein do not find favour because of their non-pliability. Resins prepared from urea and formaldehyde also have the advantage of transmitting ultraviolet light, and would therefore appear to be more suitable for incorporation in textile materials used as garments. At the present time a colourless urea resin is being used for printing bead effects on fabrics ; the appearance of such materials is excellent, and since the resin beads are pressed into the fabric a durable ornamented fabric is the result.

For finishing purposes in which it is intended to impregnate fabric with a synthetic resin so that its handle and quality are enhanced, it is essential that the resin or components of the resin should be capable of application to the fabric from a suitable solution. After-treatment such as drying or steaming is then used for rendering the resin insoluble or otherwise permanent. This necessity for applying the resin from an aqueous solution is, of course, always a difficulty in applying such substances to textile materials, and is often insurmountable. In E.P. 258,357, however, the application of urea resins is carried out in a novel manner. Actually, thiourea is used instead of urea, it being found that the formation of the resin may take place in two stages. At the end of the first stage the product is water-soluble, and this may be mixed with suitable filling substances such as starch, gums, silicates, etc., and applied to the fabric. Then the impregnated fabric is subjected to a temperature of about 130° C., whereby the second stage in the condensation occurs, the product in this case being insoluble and permanent. To assist the second stage reaction a condensing agent such as potassium tetroxalate should be present. It appears likely that it will not be long before synthetic resins are used for conferring on cotton goods permanent linen-like finishes.

Cellulose Finishes on Cotton

Pure cellulose finishes on cotton materials are also likely to be more favoured since they allow of the production of a wide range of effects. Fabrics impregnated with cellulose look to be of substantially better quality than they really are, and this effect is quite permanent : it is not removed by boiling with water or soaping, as so many present-day finishes are. Also, since the impregnated fabric may be further treated with parchmentising or mercerising liquors either wholly or locally, there is the possibility of producing special lustre effects on the fabric, which may then be finished linen-like or soft. In the past, not a great deal of success has attended the finishing of cotton materials with cellulose, mainly owing to lack of knowledge on the part of the finishers. With the increasing production of artificial silk much knowledge concerning the preparation and properties of cellulose solutions has become available, and utilisation of this by fabric finishers is likely to lead to success.

The impregnation may be effected by means of viscose or cuprammonium solutions of cellulose, and since wood pulp is about one-third of the price of cotton linters, it is generally found most economical to use wood pulp as the cellulose base. When cuprammonium solutions are employed the purity and previous treatment of the cellulose play an important part in deciding the ease of solution of the cellulose. Cuprammonium solutions are costly because of the copper they contain. On the other hand, viscose solutions are cheap to prepare, and the type of cellulose has somewhat less effect on the process of viscose formation. Fabric finishers will find it more convenient to prepare finishing solutions of viscose, the raw materials being wood pulp, caustic soda and carbon bisulphide. Provided that the preparation of the viscose solutions is always carried out in the same manner, particular attention being paid to the temperature and period of ripening of the alkali-cellulose and the actual viscose solution, they will be found to yield uniform results in finishing. But it is most important that such conditions are maintained constant ; variation of conditions considerably affects the properties of the resulting cellulose deposited in the fabric treated.

The actual process of finishing may be carried out by means of suitable padding mangles, the impregnated fabric being afterwards passed through an acid solution containing an inorganic salt such as sodium or ammonium sulphate for decomposition of the cellulose xanthate in the viscose solution and simultaneous deposition of cellulose within the fabric. The deposited cellulose contains a considerable amount of sulphur and the removal of this is effected by passing the fabric through a hot solution of sodium sulphide or sodium sulphite. Afterwards, the fabric should be bleached in the usual manner. The complete removal of sulphur is necessary since sulphur-containing fabric is liable to become tender during storage owing to oxidation of the sulphur to sulphuric acid. The possibilities in finishing fabrics with cellulose are extremely varied, and worthy of the consideration of all textile finishers.

The Lustre of Cellulose Acetate Silk

At the present time the extending use of cellulose acetate silk is drawing more attention to its defect in losing most of its lustre when treated for a few minutes with boiling aqueous liquors. Particularly is this defect noticed in natural silk and woollen materials containing cellulose acetate silk, for many processes to which such materials are subject during their normal bleaching and dyeing treatments involve boiling liquors. Thus natural silk is usually degummed at nearly boiling temperature in a soap bath, while wool is most generally dyed in boiling dye baths. Crêpe effects in wool and natural silk goods are also obtained by treatments with boiling liquors. Obviously cellulose acetate silk present during such treatment is liable to be deteriorated considerably.

Recently, however, it has been found possible to restore the lustre of cellulose acetate. The relustring process covered by E.P. 259,266 consists of treating the delustred silk in hot or boiling aqueous solutions of certain inorganic salts such as potassium chloride, ammonium sulphate, sodium sulphate, etc. This process is particularly interesting since it will be remembered that the first processs on these lines (E.P. 246,879) was based on the discovery that cellulose acetate silk does not lose its lustre when boiled in aqueous solutions, provided that a sufficient quantity of similar salts is present. In the second process (E.P. 259,265), use is made of the swelling action of certain inorganic or organic substances on the silk. It is found that if delustred silk is impregnated with a solution of a swelling agent and then dried at a moderate temperature, the dried silk has practically its normal lustre. For example, when delustred silk is steeped for about three hours in a 1 per cent. solution of benzyl alcohol at 20° to 30° C. (this is

practically a saturated solution of benzyl alcohol), then hydro-extracted and dried at a low temperature, the lustre of the silk is completely restored. Other swelling agents are acteic acid, phenol and tri-acetin.

The processes protected by the above three patents are extremely useful for they not only allow the lustre of cellulose acetate silk to be preserved or restored, but they allow it to be modified to any desirable extent. At the moment, the buying public is becoming somewhat tired of the hard bright lustre of artificial silks, and is demanding silk materials having a subdued lustre more closely resembling that of natural silk. These processes allow textile finishers to meet this new demand in the case of cellulose acetate silk.

Desulphurised and Non-Desulphurised Viscose Silk

It has already been mentioned that crude viscose silk has a high sulphur content, and that it is necessary to remove this during the course of manufacture. Certain processes, however, have been recently devised to make use of the difference between the properties of de-sulphurised and non-desulphurised viscose silk. Scholefield has paid particular attention to the possibilities in this direction, and has claimed protection for two ingenious processes (E.P. 239,981 and 261,099). Further, the possibilities have been explored by Dutch artificial silk manufacturers.

It is, of course, well known that the treatment of artificial silk yarn during such operations as dyeing affects adversely the subsequent processes of winding, doubling, etc., the effect being proportional to the duration of the treatment. Hence Scholefield carries out the dyeing and desulphurising of viscose yarns simultaneously, and thereby obtains dyed yarn which is much more amenable to after processes. In E.P. 261,099, however, advantage is taken of the fact that non-desulphurised viscose silk is not lustrous, whereas desulphurised silk has a high lustre. Fabric woven such that it contains non-desulphurised viscose silk warp or weft is printed with coloured pastes containing a desulphurising agent such as sodium sulphite, and then steamed in the usual manner adopted by printers. The printed parts are thereby simultaneously coloured and desulphurised, so that the resulting fabric appears lustrous in the coloured parts and dull in the remainder. The contrast between the high lustre and the matt ground is very pleasing, and, moreover, the non-desulphurised viscose silk has a pleasing handle. The writer feels that some risk is attached to fabrics which contain non-desulphurised viscose silk, owing to the possibility of after-tendering, as in the case of sulphur black dyed materials. It may be that actual experience will show this suspicion to have no foundation in fact.

In carrying out the last described process, direct, vat and basic dyes may be used in the printing paste. A typical procedure consists of printing the fabric with a paste containing 1·5 lb. of Benzo Purpuring 4B, 10 lb. of glycerine, 1·5 lb. of sodium phosphate, 10 lb. of sodium sulphite, and sufficient British gum to render the mixture sufficiently viscous for printing; the product is then steamed, rinsed and dried. In this particular case the red printed portions are lustrous, and show up well against a dull matt ground. The process devised by N.V. Nederlandsche Kunstzijdefabriek (F.P. 597,231) utilises the fact that the non-desulphurised viscose silk is capable of reacting with metallic salts, thereby forming coloured metallic sulphides. The depth of the colours thus obtainable may be controlled by partial desulphurisation of viscose silk. The process is easily adaptable to printing processes.

The Uses of Bentonite

During the past three years considerable publicity has been given to the uses of Bentonite, a natural siliceous substance found in America. It has been found possible to scour textile materials very efficiently when Bentonite is present in the scouring liquors. Bentonite also has an affinity for cotton and other fibres so that it may be used for finishing purposes. A particularly interesting use of this substance is as a substitute for tannic acid as a mordant for basic dyes. When cotton is steeped in a colloidal solution of Bentonite, washed free from loosely adhering particles, and then immersed in a solution of a basic dye such as Methylene Blue, rapid absorption of the dye takes place. The cotton holds the dye fairly tenaciously during washing and soaping, and for some purposes Bentonite might find a use in this direction. The mordant action of this substance is, however, much inferior to that of tannic acid or Katonol.

Finally, attention may be drawn to some interesting possibilities revealed by the work of Karrer and Wehrli (*Helv. Chem. Acta*, 1926, 9, 591) on immunised cotton. Immunised cotton results when ordinary cotton is mercerised and esterified in an organic solvent with para-toluene-sulphochloride; it has practically no affinity for direct cotton dyes. These recent investigations show, however, that when the immunised cotton is heated at moderate temperates with aqueous ammonia, the cotton becomes ammidated, the toluenesulpho groups being simultaneously split off. The important point is that the ammidated cotton has a substantial affinity for wool acid and mordant dyes. There are very large commercial possibilities for methods of producing cotton having these new dyeing properties, particularly since such methods applied to viscose silk would produce a rival to cellulose acetate silk.

The past year has not been very successful in the dyeing and finishing industry from a financial standpoint, but it has revealed many new methods and ideas likely to find wide application in the near future.

Synthetic Dyes

A LECTURE on the development of synthetic dyes was given on Monday in the chemistry building of Birmingham University, by Mr. J. H. Geoffrey Plant, a research chemist of the Carbonhydrate Research Department. Professor W. W. Haworth presided.

The lecturer said the first synthetic dyestuff (mauvein) was discovered in 1856 by William Henry Perkin, and the second (magenta) in France three years later. From these discoveries Mr. Plant showed how systematic chemical research had made possible the enormous range of manufactured colours available to-day of a fastness and delicacy not found in the colours obtainable from natural sources. The method by which the structure of alizarin, the colouring principle of madder, had been proved was shown, and how synthetic indigo had ousted the natural product. The lecturer also reviewed the commercial position, particularly stressing the effect of the war. In 1914, England was faced with a complete stoppage of dyes from Germany, where the formation of syndicates to minimise internal competition had established a world monopoly and control. Fortunately, a timely Government subsidy helped to found what was now the British Dyestuffs Corporation, while private enterprise had also won through the very difficult period.

Five Washing "Don'ts"

A FOLDER issued by a silk dyeing company contains the following "don'ts" for guidance in washing hosiery:—

Silk hose should be washed after each wearing in order to avoid strenuous cleansing methods, and action of perspiration on the fibre.

Do not rub soap on the hose direct, but dissolve the soap first.

Do not use hot water. Create a good lather in warm water with any good neutral soap, then add cold water until lukewarm, work suds through stockings by dipping up and down.

Do not allow stockings to remain in suds. Entire washing should not consume more than three or four minutes. Rinse in two lukewarm waters and squeeze out. Do not wring.

Do not expose to strong light while damp. Dry indoors. Do not expose to strong light, especially rays of light transmitted through glass.

Do not dry on radiator. Avoid drying on radiator as excessive heat is detrimental.

Dye Research in Washington

THE Government's research work in colour chemistry has evidently produced results that justify its value to industry. An appropriation of $72,921 for the Colour Laboratory of the Bureau of Chemistry is included in the latest appropriation bill of the Department of Agriculture. The Colour Laboratory has made a number of valuable scientific studies of the chemistry of dyestuffs, which have undoubtedly added to knowledge of the constitution and properties of dyes and to that extent have directly benefited both the dyestuff and textile industries. It is suggested that there should be closer co-operation between the dye industry and the Colour Laboratory, for the advancement of technical knowledge.

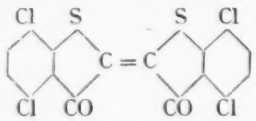
Technical Progress in Dyestuffs in 1926

By L. J. Hooley

In this article the author continues and completes his review of the technical progress in dyestuffs research and production during the past year.

Indigo Dyes

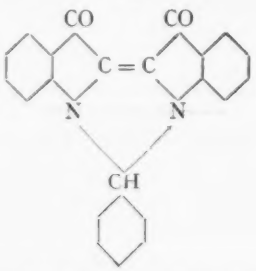
NEW indigo derivatives belong largely to the substituted thioindigos, and naphthalene and unsymmetrical indigos. Dodd, Sprent, and the United Alkali Co. find a new use for the bye-product *p*-dichlorbenzene in B.P. 251,321 by using it for the synthesis of tetrachlor thioindigo:



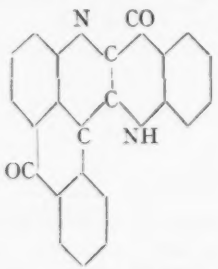
Treating it with chlorsulphonic acid, they introduce an SO_2Cl group, reduce this group to the mercaptan, combine the mercaptan with chlor acetic acid, and then condense the resulting dichlorphenyl-thioglycollic acid to the indigo in cold sulphuric acid. The yields throughout are excellent.

In B.P. 254,340, the I.G.F.A. prepare the corresponding 5 : 5′; 6 : 6′ tetrahalogen 4 : 4′-dimethyl thioindigos, by halogenating the 6 : 6′ dihalogen 4 : 4′-dimethyl derivatives. The resulting shades are reddish violet. In B.P. 254,743 they extend the halogenation to the corresponding 4 : 4′ : 6 : 6′ tetrahalogen or tetra-methyl bodies, obtaining violet and violet red shades. These are almost extreme examples of substituted indigos, and although methyl and halogen groups do not usually produce much colour change, the effect of their introduction to such an extent as in the above, produces a deepening from red to violet.

The dyestuff Indigo Yellow 3G, Ciba, obtained by the action of benzoyl chloride on indigo in the presence of nitrobenzene and copper powder is usually assigned the constitution attributed to it by its discoverer Engi, and shown below:

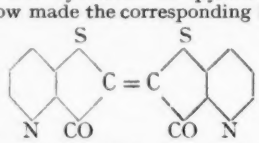


Posner and Hofimeister (Ber., 1926, 1827), however, consider that a fundamental change takes place in the indigo molecule in the formation of this dyestuff and give as its formula:



which makes it a derivative of anthraquinone. The argument in favour of this latter formula cannot be given in detail, but it may be mentioned that Ciba Yellow 3G gives phthalic anhydride on oxidation and that unlike the indigo derivatives which give weakly coloured vats, generally pale yellow, this substance gives a violet vat. This bathochromic effect is more in line with some of the anthraquinone colours, particularly flavanthrene. The above forms portion of one of two papers dealing generally with the space formula for indigo.

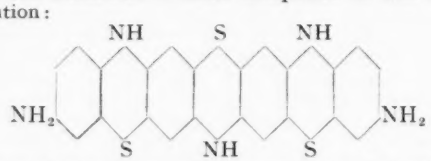
Following on the synthesis of pyrindigo, Plazek and Sucharda have now made the corresponding 8 thio pyrindigo:



The colour is red violet as against the red of thioindigo and by virtue of the basicity of its pyridine rings, the new product in addition to being applicable by the vat process, can be also dyed as a basic colour, from a suspension in dilute hydrochloric acid.

Sulphur Colours

The last year's published work on sulphur colours, although varied in character, does not amount to more than moderate proportions. In fact, considering the good fastness of these colours, combined with their general cheapness and excellent tinctorial properties, it is doubtful whether they are receiving the attention they deserve or have been doing so for the last fifteen years. Logical development is made more difficult in the sulphur series, by the fact that so little is known of constitution. Although research is carried on along less simple lines than those of the eighteen-nineties, when any organic material or waste was submitted to a sulphur melt, it still labours under considerable handicaps. Dealing with the elucidation of constitution, H. H. Hodgson has published results on the action of sulphur on monochlor aniline and the mechanism of aromatic thionation (J.S.D.C. 42.76). A. Beretta has described a black compound of the following constitution:



which was obtained from 4′-benzenazo-2 : 4–dinitrodiphenylamine through reduction to 2 : 4 : 4′ triaminodiphenylamine followed by formation of the thiodiphenylamine nucleus and condensation of two of these nuclei (Giorn. Chim. Ind. App. 1926, 121).

Many of the special properties of sulphur dyestuffs are easily explainable in terms of sulphur radicles and linkages in various degrees of oxidation. Perret discusses the behaviour of sulphur colours as regards self-heating effects, changes on keeping, development of acidity and changes during dyeing, from this point of view in Ann. Chim. Appl. 1926, 69 with reference to Sulphur Black. The effect of susceptibility to oxidation on fastness is well known and explains the lack of fastness to bleaching in the majority of sulphur colours. Products free from this latter disadvantage are claimed in B.P. 247,378 (A.G.F.A.), where they are obtained, for example, by the sulphurisation of the indophenol from 4 amino 4′ hydroxy diphenylamine and benzaldehyde and also in F.P. 588,874 (Kalle), where dihydroxy bodies such as quinols are condensed with amino carbazoles and polysulphides, to give blue and black dyes. Other examples obtained from carbazole derivatives are to be found in B.P. 247,378 (A.G.F.A.) and B.P. 243,557 (Bayer).

Schaarschmidt and Lewyeff have purified and analysed Cibanone Orange R, which obtained from 2 methyl anthraquinone and sulphur and found the presence of one atom of sulphur for each molecule of methylanthraquinone. They were unsuccessful in an attempt to prepare an oxygen analogue by the use of persulphate instead of sulphur. Cibanone Orange being dyed by the hydrosulphite method belongs to the class which can only be considered as sulphur colours by virtue of their constitution. New examples of the vat-sulphur type are given in D.R.P. 427,970 (I.G., Binapfl and Strohmenger), being obtained by heating azobenzene with substances such as *o*-cresol and sulphur.

Products prepared in the presence of copper are given in U.S.P. 1,568,622 and 1,580,716. Other sulphur compounds are mentioned under the wool vat dyestuffs.

Basic and Triaryl Methane Colours

Two or three papers on the constitution of various basic dyestuffs have appeared in *Helvetica Chimica Acta* during the year, and a few diverse patents have also been taken out. These were discussed in THE CHEMICAL AGE of December last and will not be further commented on here. The di- and triaryl methane brands of the basic colours are of more importance; these although basic in the first instance appear also as acid colours, azo, azo-chrome and azo pyrazolone dyestuffs. Very complicated derivatives are described in B.P. 256,775 (B.D.C. and K. H. Saunders). Using their previously patented amino sulphones, these are condensed with Michler's hydrol, diazotised and then coupled with phenyl methyl pyrazolones and give yellow shades on wool.

The introduction of chlorine atoms into a dyestuff, although having little effect on colour depth, often gives increased brightness. An example of this is seen in B.P. 250,785 where *o*-sulphobenzaldehyde is condensed with two molecules of alkyl-benzylarylamines containing halogen atoms in the benzene nucleus, the resulting products being brighter than the corresponding ones without the chlorine.

In B.P. 249,160 and 250,265, rather complicated amines such as dialkyl-diphenyl-ethylene-diamine and dinaphthyl-ethylene diamine are used in triarylmethane colours.

Azo Colours

The azo colours are of such great variety and the number of new products so large that it is only possible to mention the more important directions in which research is specially proceeding, and further details must be sought in the preceding issues of THE CHEMICAL AGE Dyestuffs Supplement.

The chrome and the insoluble azo colours provide the most noteworthy developments. The increase of fastness by the use of dyestuffs in complex molecules with metals is being exploited fully, and in addition to various methods for after-treatment further attempts are being made to produce chrome dyestuffs which, already containing the metal before dyeing, can be used directly and the chroming process proper eliminated. The search for new constituents for insoluble azo colours continues. The pyrazolones are being extended and used in conjunction with other types of dye molecules including the triphenyl methanes. A large variety of new intermediates for all the various subdivisions of the azo colours are also being continually brought out.

Intermediates

Among intermediates there are a large number of special ones for new dyestuffs, some of which are mentioned under the respective dyestuffs which are synthesised from them. As regards general methods of preparation and individual basic intermediates a few only can be mentioned. S. W. Leitch and Co. and A. E. Everest (B.P. 257,479) find a use for *p*-toluene sulphonic chloride in the sulphonation of amines. Thus *p*-toluidine is condensed with *p*-toluene sulphonic chloride and the condensation product then treated with about three times its weight of sulphuric acid, when sulphonation takes place in the ortho position to the amine accompanied by hydrolysis of the added group.

Details for the production of amino hydroxy bodies in good yield by the electrolytic reduction of nitro bodies are given in B.P. 254,204; nitrobenzene gives *p*-amino-phenol. Sulphocyano groups are introduced by the simultaneous action of halogens and metallic sulphocyanides in B.P. 257,619. Ethylene disulphocyano is obtained from ethylene by this reaction.

A mixture of 1 : 6 and 1 : 7 nitro naphthalene sulphonic acids is obtained by treating molten naphthalene with little more than its own weight of monohydrate and then nitrating and, if desired, also reducing, without isolation (U.S.P. 1,594,547, Nat. Aniline Co.).

The corresponding 1 : 4 and 1 : 5 naphthylamine sulphonic acids may be made by subjecting 1-nitro naphthalene to the action of ammonia and alkali sulphites under pressure (E.G. Elhrhardt and H. M. Hereward, B.P., 254,402).

β-Naphthisatin treated under pressure with caustic soda and an oxidising agent gives naphthalene 1-carboxylic acid 2 amino (B.P. 252,820). Naphthalene 2 hydroxy 6 carboxylic acid is produced along with the isomeric 2 : 3 body by heating potassium β-naphtholate with carbon dioxide under pressure at 170° to 230° C. (B.P. 257,815, I.G.).

Immunisation

As a result of a good deal of investigation into the application and dyeing of immunised cotton more information is now available on the properties of this fibre. Its formation by the esterification of cotton with acid halides, especially *p*-toluene sulpho chloride, immediately recalls that of acetyl silk, and its properties show a corresponding similarity. It has a harsher feel than ordinary cotton and a greater resistance to water, while at the same time it loses much of the affinity which cellulose itself has for dyestuffs. By weaving immunised fibre into untreated fibre, the fabric can be dyed so that the coloured portions remain as white effects. It can itself be dyed if the right class of dyestuffs are used; these are usually of the same type as those for Celanese, and a colour which will work with one will usually do so with the other. The Imacols have been brought out by the Sandoz Co. for the special purpose of this new fibre. They dye directly from an aqueous bath at about 80° C., leaving cotton uncoloured. The immunisation process can also be used after dyeing, with the effect of increasing fastness. It has also been applied to some extent with animal fibres as well as vegetable.

Dyeing

Several interesting points in dyeing come up for notice. Azo colours do not at first sight appear suitable for dyeing along with the vats, but the fabric can be impregnated with the leuco compound of a vat dyestuff in the usual way along with one component of an insoluble azo colour, and the cloth thus treated then passed through a second bath containing other azo constituents and sodium nitrite, which develops the azo colour and at the same time oxidises the leuco vat colour. Both colours are thus formed *in situ* on the fibre (B.P. 252,384, I.G.F.A.). A similar process with the ester salts of vat colours has already been described.

Basic colours are obtained fast to light by W. Eberlein and Colloisil Colour Co., Ltd. (B.P. 247,328), by applying these along with an artificial silicate in colloidal form, the silicate being used along with or before the dyestuff and the colour then precipitated in lake form by heat or treatment with an electrolyte.

Haller discusses the influence of the addition of a large variety of substances to the indigo vat. There appears to be no very striking advantages to be gained by the use of any of these, and cases where the dyeing is accelerated or deeper shades produced are often accompanied by decreases in fastness (*Textiliber.*, 1926, 612). Durst and Roth describe methods of analysing vat dye baths, particularly the determination of the hydrosulphite present without disturbance by the leuco compounds present (Z. angew. Ch. 1926, 900).

C. S. Bedford has another patent (B.P. 253,662) on the dyeing of chrome wool colours, using sodium thiosulphate as a reducing agent for the dichromate, so that this latter is obtained completely as chromium hydroxide, which is the form in which the chromium gives the fastest shades.

Textile fabrics are printed or dyed on one side by passing the calendered goods transversely through a cloud of the atomised dyestuff solution (Two-Tone Corp., B.P., 236,194). Details of applying chromium compounds of azo and other dyestuffs and after-treating with substances such as zinc chloride or lead acetate are given by the B.A.S.F. in F.P. 599,566.

Among an almost bewildering variety of wetting out agents, and assistants for dyeing and printing which are already available and continually being added to, the alkyl naphthalene sulphonic acids of the I.G.F.A. may be mentioned.

Printing

Evidence as to the antiquity of printing is given by Reinking (*Textilberichte*, 1926, 230), who cites the account of the campaigns of Cyrus round the Caspian Sea, given by Herodotus. The natives of this region are stated to have used a colouring matter extracted from trees or perhaps shrubs, for painting animal figures on garments. The effects are stated to have been very fast, and "to last as long as the material itself." It would appear highly probable that the colour was related to indigo.

Among contemporary work on printing indigo, a note sealed in 1912 by C. Sunder and S. Rolbach dealing with coloured discharges on indigo grounds with indanthrene and helindone dyestuffs has been recently published (Bull. Soc. Ind. Mulhouse, 1925, 755). A similar note by Pokorny on white and red discharges is given in the same journal.

Mechanical resists of mixtures of flour, glue, and gum arabic are given in B.P. 247,757 (S. W. Clark and J. R. Brown). After printing the resists are removed by washing. Sieber (*Textilberichte*, 615 and 244) discusses the advantages, such as greater clearness in discharges, obtained by using potassium salts instead of sodium salts in printing pastes. He also gives a recipe for the preparation of pastes which will not attack the printing rollers.

There are in addition other points of interest, these being principally in connection with discharge work.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

It is very pleasant to report a progressive improvement in the dyestuff business during the month of January. The improvement is not confined to any particular class of colour, but is so general that it may be regarded as an indication of a widespread betterment of industrial conditions.

Despite the chaos in China, there is some improvement in the cotton trade with promise of better times in the near future. During the month slow progress has been made in the task of the general reorganisation of the industry. The banks would appear to have had no difficulty in discovering excellent reasons for doing nothing, and a suggestion has even been made that a Royal Commission should be appointed to investigate the position. In the meantime the American Yarn Association, Ltd., is endeavouring to get the support of 70 per cent. of the spinners, which support it insists upon having before commencing operations to regulate the cotton spinning section of the industry. Would any other than an hereditary foe from Sheffield take advantage of such humiliation?

During the month the British Dyestuffs Corporation, Ltd., has transferred its headquarters from Spring Gardens to its Blackley factory. The name "Hexagon House" has been given to the handsome building in which are brought together the staffs of the technical, commercial, and secretarial sections of the company. It is understood that rooms have been retained at the old address, 70, Spring Gardens, for the carrying on of local business.

It is interesting to note that a committee, under the chairmanship of Mr. Scholefield, has been appointed by the Society of Dyers and Colourists to investigate the question of the standardisation of the fastness properties of dyestuffs.

Yorkshire

January has proved to be somewhat trying to the optimist who forecast better things for 1927. Perhaps his optimism is hardier than to be discouraged by the results of the first month's trading, but be that as it may the boom that was supposed to be straining at the leash (the latter in the form of a coal stoppage) does not appear to be getting under way, and one wonders whether its spirit has not been more or less permanently broken by its lengthy bondage and consequent heavy handicap in the international competition.

Chinese internal conditions have for long been blamed for loss of much trade to Yorkshire, but not in recent years has the effect been so severely felt as during the month under review. Dyers of cotton warps and pieces and manufacturers and dyers of low unions, amongst others engaged in the textile industry, are affected. Sulphur blacks and browns for warps for cross dyeing and sulphur blacks for pieces are in less demand in consequence. For refreshing contrast, it is well to turn to the *Yorkshire Observer* of January 13 and read of the progress of the firm of Wm. Denby and Sons, Ltd., of Tong Park, Shipley, dyers and finishers. Substantial additions to their works have been made during last year, notwithstanding the trade depression. The undertaking was founded over a century ago, and their trade has grown so rapidly that this extension is the third that has taken place during the last five years.

Coke ovens are rapidly developing to full operation and with increasing demand for sulphuric acid; benzene is somewhat easier; toluene and xylene, however, are still scarce. Pure toluene is quoted at 2s. 4d. per gallon makers' works. Carbolic acid (crystals) is dropping and quoted now at 6¼d. per lb. British makers of sodium sulphide have reduced their prices, whilst increased prices are quoted for German manufacture. Some ruthless price cutting by Yorkshire dyestuffs makers has occurred.

Surplus chemical plant and machinery is notified for sale by auction at the Griffin Hotel, Boar Lane, Leeds, on February 23 and following days by Fuller, Horsey, Sons and Cassell, of 11, Billiter Square, London, E.C.3. The plant lies in Yorkshire works and is of a class interesting to dyestuff makers.

Midlands

February has opened up very quietly in the hosiery trade. Optimists have disappeared, and in every department of hosiery dyeing short time is being worked, and there seems no prospect of improvement in the immediate future.

In the woollen section there is a steady demand for hose and half-hose, and one or two spinners are working full time; others are not so fortunate. Woollen fabric has slowed down considerably.

Cotton.—Yarn dyers are fairly well employed with sewing and backing cottons. Knitted fabrics are not good. Hose is in very poor demand: manufacturers are still complaining of foreign competition. Fadeless lace curtains are selling steadily.

Artificial Silk.—Panel hose has not yet recovered from the slump. This important branch of the hosiery trade has not suffered such a long depression for many years. Knitted fabrics show no improvement.

Natural Silk Hose.—No appreciable change. Manufacturers are able to dispose of their output, which is not large at present.

Leather.—According to some newspapers there is a boom in the boot trade. We have not yet been able to find a manufacturer who knows anything about it and several tanneries in this area, which make boot upper leathers, are decidedly slack, although there is a steady demand for coloured glazed kid.

Hose dyers are busy with their summer pattern cards. Manufacturers are again asking for fancy effects. The ever-increasing demand for novelties makes a laboratory and separate staff for experimental work an absolute necessity. Hitherto many dyers in the Midlands have looked upon chemists and a laboratory as luxuries.

Prices for dyestuffs remain very steady; slightly lower figures are occasionally heard of for contracts.

Scotland

The market tone in Scotland during January was uncertain; while inquiries were numerous, reflecting the general note of optimism which opened the New Year, orders have been disappointing and buyers hesitant. Evidently the position is being probed to see how far the promises of the beginning of the month are sound; no improvement is visible yet and judgment is in the meantime reserved. This feeling characterises not only the dyestuffs but the chemical market generally.

The cotton and artificial silk branches are finding business intermittent, as it was at the end of the year. Yarn dyers are busier than piece dyers, and bleachers are in some cases full up. Wool dyers are well occupied and there is no sign of any lessening of the vogue for knitted goods. Dress goods and hosiery maintain their level of prosperity with perhaps a slight falling off in overseas demand, but with spring orders promising well. Linen and jute remain unsatisfactory and jute workers' wages have been reduced in Dundee.

A successful and well attended meeting of the local section of the Society of Dyers and Colourists was held in the Grosvenor Hotel, Glasgow, on January 21. Mr. J. S. Wilson dealt with the application of the vat colours to substances other than cotton, and the interest evoked was shown by the discussion that followed. Active inquiries are being made in the application of the anthraquinone vat colours to wool by some of the important woollen goods manufacturers.

Further enlargements to the Grangemouth dyeworks of Scottish Dyes, Ltd., are foreshadowed in a recent application to the Dean of Guild Court.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMIC AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.*

New Icyl Colours on Viscose

THE British Dyestuffs Corporation issue a pattern card of more than usual interest, illustrating the shades of the first members of a new series of direct dyestuffs which are specially designed to yield even results on viscose artificial silk of irregular quality. As is generally known, owing to the manufacturing methods peculiar to the production of artificial silk, certain irregularities are bound to occur and are, in fact, stated by the manufacturers to be unavoidable, in the quality of the finished product. These irregularities, in turn, give rise to irregular results in colouring, and it is no uncommon thing to find in an artificial silk dyehouse a large number of girls employed solely in sorting dyed material into lots which roughly match one another. The harassing time which dyers of artificial silk have had in the past may be imagined.

It is confidently expected that with the introduction of the Icyl dyestuffs these difficulties will disappear, and seeing that the problem is one which has engaged the attention of dyestuff manufacturers, both home and foreign, for a great number of years, the British Dyestuffs Corporation are entitled to feel some pride in the fact that it has fallen to the lot of a British dyestuffs firm to discover the solution.

The colours illustrated do not represent the full series: new members will be added as time goes on, and it is hoped eventually that with the completion of the series it will be possible to provide for the production of every hue which may possibly be devised. The colours shown on the card number ten, and from each of these, with different strengths, varied shades may be obtained. The present range of Icyl colours consists of Orange G, Orange R, Brown G, Violet B, Blue G, Blue Black 6B, Chrysophenine G, Chlorazol Fast Red K, Chlorazol Fast Helio BK, and Chlorazol Fast Black BK.

Equally good results are anticipated from these new colours, whether the variation in the viscose silk is due to manufacture or is created by unequal stresses set up during the knitting or dyeing of the fabric. Dyers are invited to co-operate with the B.D.C. by reporting their experiences with Icyl colours. It may be added that these colours are applied in the same manner as are the direct cotton colours. With viscose showing average variation, no special precautions are necessary, but if wide variation is met with, the conditions found to give the best results with ordinary direct colours will also prove beneficial with the Icyl colours. These conditions are high temperature and small additions of salt or Glauber's salt to the dyebath.

New British Colours

THE most recent celatene colour, Celatene Brilliant Blue, produced by Scottish Dyes, Ltd., is an important addition to the celatene range of acetyl silk colours, as on account of its fastness to light it may be used for guaranteed fabrics, including mixtures of acetyl silk with cotton or viscose, the cotton or viscose being dyed with Caledon colours. It is distinguished for brilliancy of shade, in this respect being distinctly brighter than Celatene Blue. It is fully up to the standard of the latter colour as regards fastness to washing, and in other particulars is equal to the best of the celatene colours. It is said to combine well with Celatene Fast Light Yellow, and is the most effective blue for bright fast green shades. The sample colour card shows 2 per cent. and 10 per cent. dyeings of Celatene Brilliant Blue, and a mixed dyeing of 12 per cent. Brilliant Blue with 8 per cent. Fast Light Yellow. The effects, in all cases, are brilliant.

"The Dyeing of Cotton Fabrics"

ERNEST BENN, LTD., have just issued a third edition of this work by Franklin Beech, revised and enlarged by A. J. Hall (pp. 296, 18s.). The last edition appeared in 1917. In preparing the new edition Mr. Hall has taken the opportunity of bringing the volume more into line with modern requirements. The most notable addition is an entirely new chapter (VII) on the dyeing of artificial silk of both the viscose and celanese varieties. The mode of application of the various classes of dyestuffs to these increasingly important textiles is described. Details are given for dyeing with S.R.A. colours, Ionamines, Celatenes, etc., but the Duranol colours of the B.D.C. are not mentioned. In the section on vat dyeing some additional matter has been incorporated dealing with those colours derived from anthraquinone. In an essentially practical book the present state of development has not been considered sufficient to warrant exclusion of the older methods of dyeing indigo in favour of a description of indigosol and the other recent advances in solubilised vat colours. Considerable attention is rightly given to aniline black dyeing, and some general information relating to the use of sulphur colours has also been included. The first chapter, dealing with cotton itself, has been extensively revised and the subject matter brought more into line with our present knowledge of the chemistry of cotton. Advances in technical development since the last edition are illustrated by drawings and photographic reproductions of modern dyeing machinery. The main section of the book dealing with numerous recipes for dyeing cotton all shades with all classes of dyestuffs remains substantially as before. The new edition should be assured of an increased sphere of usefulness.

The Guild Trichromatic Colorimeter

A GOOD deal of work on the production of a reliable colour measuring instrument suitable for general purposes has been going on in recent years in the Optics Division of the National Physical Laboratory. As a result of these investigations, Mr. J. Guild (of the N.P.L.) designed a trichromatic colorimeter, the scientific basis of which he has described in various papers. The original model was constructed at the N.P.L. in 1922, and the instrument has been under observation and in practical use there ever since. Adam Hilger, Ltd., of Camden Town, London, have placed on the market an instrument of this type, redesigned for general industrial use. Their Guild Trichromatic Colorimeter enables any colour examined to be expressed as definite amounts of the three primaries—red, green, and blue.

Description of the Instrument

IN exterior appearance the colorimeter consists mainly of a metal box containing the essential parts of the apparatus, there being attached a bracket on which is mounted a lamp with a lens to collect and direct the light. The light from the lens enters the box through three variable openings each covered with a glass colour screen. These serve as

three primary colours which are combined in the instrument in varying proportions at will. The operator looks through the telescope directly at the colour to be measured and observes below it the colour composed in the instrument out of the three primaries. Each primary can be adjusted separately by its own adjusting handle, and the operator has merely to match this compound colour against his unknown colour by manipulating these handles. A match being secured, the finished measurement is then recorded as the amount of each primary constituent, this being derived from the final apertures of the variable openings. The resulting measurement is thus expressed simply as definite amounts of each of the primaries—red, green, and blue. When necessary these results may subsequently be transformed by a simple arithmetical calculation by which they would be referred to a common basis and rendered independent of the instrument primaries. Examples are given in the booklet issued by the makers, various colours shown being represented for example by the formulæ red 2, green 39, blue 59; red 53, green 31, blue 16, etc. The instrument measures and specifies colour numerically, and any such colour can be reproduced from the numerical specification whether on the same instrument or on any other one of the same design. Each instrument is tested and certified at the N.P.L., where it has been approved and is in use for research and standardisation purposes.

Advantages and Uses of the Instrument

IT is claimed that the instrument possesses the following features essential for the practical measuring, recording, and control of colour in industry: (*a*) It is convenient and rapid in practice, and any intelligent person can be taught to use it and to obtain accurate results without the special scientific training necessary to an expert; (*b*) the arrangements for measuring are of highly accurate character; (*c*) with all the advantages of a three-colour system it is free from the defects to which instruments of this class have been liable in the past, owing partly to the improved device for colour mixing, and to the provision of means for measuring colours of high saturation; (*d*) all colours, including purples, may readily be measured, and the great majority of such colours may be reproduced on the instrument. The colour of any article, such as fabrics, pigments, dyes, etc., can be measured by its means, simple modifications in setting up being the only difference in procedure for different objects. Some very intense (saturated or spectral) colours require a double measurement to be made; but there is no essential difference in the manner of measurement for any colour. Among the industries and trades to which the colorimeter may be of interest are: dyestuff manufacture; brewing; calico printing; dyeing; paint and colour manufacture; oil manufacture; paper making; soap making; sugar refining, etc.

Dyestuff Licences in February

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during February, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 498, of which 382 were from merchants or importers. To these should be added 11 cases outstanding on January 31, making a total for the month of 509. These were dealt with as follows:—Granted, 449 (of which 437 were dealt with within 7 days of receipt); referred to British makers of similar products, 42 (of which 36 were dealt with within 7 days of receipt); referred to reparation supplies available, 8 (all dealt with within 2 days of receipt); outstanding on February 28, 10. Of the total of 509 applications received, 481, or 94 per cent., were dealt with within 7 days of receipt.

New American Colours

THE Newport Chemical Works, Inc. (U.S.A.), announce three new colours just placed on the market, namely, Newport Fast Acid Blue SR, Newport Acid Anthraquinone Blue B, and Newport Fast Chrome Brown EB. The first is recommended for the dyeing of woollen piece goods, yarns, felt, shoddy, etc., in all types of machines. It is said to be of value for shading chrome navies and blacks, as well as for dyeing wool in union materials from a neutral bath. The principal use of the second is for dyeing light and medium blues, and for combining with other level dyeing acid colours for the production of slates, greens, drabs, etc., on carpet yarns, plush, dress material, knitting yarns, hat felts, etc. It is said to dye pure silk well from acid baths. The last is recommended for dyeing light and medium shades as well as mode shades on wool in all stages of manufacture.

Too Many Colours?

ELIMINATION of waste is to-day (according to an American dyestuffs journal) a universal subject, and the chemical industry in several of its most important and highly competitive branches is working towards uniformity of specifications for quality, strength, packing, etc., and towards the elimination of duplication of effort, thereby effecting a great saving in capital and increase of profit. It is reported (the journal states) in unofficial quarters that the I.G. in its process of reorganisation and consolidation, will reduce the number of its dyestuffs, which is estimated to be between seven and eight thousand, to a figure between two and three thousand. This is apparently considered adequate to take care of all requirements of their world's business, and result in elimination of duplication and a reduction of operating costs. Many of the factories now a part of the I.G. were formerly producing the same colour under different names, and the whole range of colours will be standardised for the I.G. as one concern.

The Demand for "Fast" Fabrics

GRADUALLY the public are beginning to appreciate the practical meaning of the term "fastness," and both in this country and in America emphasis is now placed in business announcements on the guarantee with certain goods that their colours are permanent. In the advertisements of a large London store, one notices the prominence given to the word "Everfast" in the description of certain fabrics. An American advertisement contains this typical sentence: "You can't drive the Aniline Fast Black out of Coal-Tex suitings," and adds the name of the company's chief dyer and the record of his 33 years' experience. Such advertising, the *American Dyestuffs Reporter* states, "is but another sign that an educational campaign is now fully under way throughout the textile industry, with its purpose to teach the consumer and the trade that fast colours are well worth every cent of their slightly higher cost. The current advertising of the Du Pont Company is planned on the same theme, to assist in spreading fast colour education among mills that are not yet convinced that the public demand is more than a passing fad. This agitation for faster goods, moreover, has not been started by a few enterprising manufacturers. The public—the shoppers themselves—have been heard from on the question. The Du Pont advertising contains reference to an article on fast fabrics which lately appeared in *Good Housekeeping*, from which we learn that 84 per cent. of the readers of that magazine ask for guaranteed fast colours when buying apparel or dress material. Trade-marked fast-colour fabrics will ultimately form the bulk of textile goods."

The Dyeing of Cotton and Artificial Silk Fibres

How Pre-treatment may Affect Dyeing Properties

By A. J. Hall, B.Sc., F.I.C., F.T.I.

Although the introduction of cellulose ester artificial silks, particularly cellulose acetate silk, and the associated difficulties of dyeing have spectacularly shown the necessity for dye manufacturers to keep well informed of progress made by textile technologists, it is but one of the many reasons for this necessity. Methods of treating textile fibres for the production of special effects of lustre, handle and appearance usually affect definite changes in the properties of the treated fibres and to dyers and finishers such changes usually mean difficulties. In the following article some peculiar dyeing properties of treated cellulosic fibres are described and their importance to dyers and dye manufacturers indicated.

PROBABLY one of the most interesting treatments of cellulosic materials which considerably affects their dyeing properties is that discovered some sixty years ago by John Mercer. When Mercer, engaged in the filtration of caustic soda through cotton cambric, noticed that the cotton swelled and increased in weight he was also particularly struck by its increased dyeing power. In fact, Mercer apparently failed to observe those conditions of the treatment essential to the production of increased lustre, and concentrated his attention to the possible dyeing advantages to be obtained by mercerisation before dyeing. Throughout his life he cherished the idea that mercerisation would ultimately be carried out for increasing the affinity of cotton for dyestuffs. In this he was but partially correct, for though cotton materials are frequently mercerised for the sole purpose of facilitating the production of very deep shades, mercerisation is usually regarded as a means for modifying the lustre and handle of yarns and fabrics.

The most obvious feature of mercerised cotton fibres is that they have an increased affinity for direct dyes. In general, a mercerised fabric will dye to a depth of shade which is about twice that of similar non-mercerised fabric, both fabrics being dyed together in the same dye bath. This fact must not be taken as firm support for the assumption that the amount of dye absorbed by the mercerised fabric is twice that absorbed by the non-mercerised material. In fact, among mercerisers there is sometimes found a belief that the dye within mercerised fibres is more effective than that within non-mercerised fabrics, although the writer has not discovered any conclusive evidence for this belief. It is also found that mercerised cotton fibres absorb dyes more rapidly.

The increased affinity of cotton for dyes produced by mercerisation is dependent on the conditions of mercerisation. As will be seen this is most unfortunate as regards dyers since it is practically impossible to ensure that commercial mercerisation of cotton materials, particularly yarns, is carried out uniformly. Some twenty years ago Pope and Huebner in their well-known investigations on mercerisation found that the curve shown in Fig. 1 approximately indicated the relation

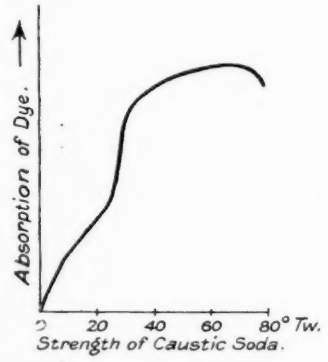


FIG. 1
CURVE SHOWING THE VARIATION OF DYEING POWER OF COTTON MERCERISED WITH CAUSTIC SODA OF INCREASING CONCENTRATION.

between the strength of caustic soda used in mercerisation and the amount of Benzopurpurine 4B absorbed from a dye liquor by the mercerised cotton. The relation is obviously extremely irregular, and this adds to the difficulties of dyers.

But the affinity of a mercerised cotton fabric is not dependent on the strength of the mercerising liquor alone. It is further dependent on the degree of stretching to which the cotton is subjected during the treatment, to the presence of inorganic salts, to the temperature of the mercerising liquor, and to the aftertreatment of the mercerised cotton before dyeing. All these effects are influenced by the type of cotton (whether fine or coarse) and the twist in the yarns.

Increased stretching decreases the dyeing affinity. This is clearly shown by the following results obtained by Knecht (*Journ. Soc. Dyers and Col.*, 1908, xxiv, 67 and 107).

Conditions of mercerisation.	Benzopurpurine 4B absorbed. Unbleached. Per cent.	Bleached. Per cent.
Non-mercerised cotton	1·55	1·50
Cotton mercerised under tension..	2·90	2·86
Cotton mercerised without tension	3·39	3·54

In the mercerisation of cotton yarn in skein form it is almost impossible to prevent some portions of the skeins being stretched more than others, the result being the production of portions of yarn within the same skein having different dyeing properties.

The increased affinity of mercerised cotton for dyes is inversely proportional to the temperature of the mercerising liquor. Cotton mercerised at a low temperature (say about 0° C.) dyes to a heavier shade than cotton similarly mercerised at moderate temperatures (say, about 50° C.). The presence of salts such as sodium chloride or sulphate in the mercerising liquor also decreases the dyeing properties of the resulting mercerised cotton.

After mercerised cotton is soured and washed free from acid, its affinity for dyes is considerably affected by drying. Drying reduces its affinity for dyes, as is obvious from the following results :

Condition of Cotton.	Absorption of Benzopurpurine 4B. Per cent.	Chrysophenine. Per cent.
Mercerised and dyed before drying..	2·49	0·97
Mercerised and air-dried before dyeing	1·57	0·77
Mercerised and dried at 100° C. before dyeing	1·27	0·54
Unmercerised cotton	0·80	0·31

The dyeing of mercerised cotton goods therefore demands that special precautions must be taken to obtain even and well penetrated shades. It may at first be thought that satisfactory dyeings are thus dependent on the dyer only; that by the use of suitable assistants in the dye bath and regulation of the temperature of the dye bath inequalities of mercerisation may be smoothed out. This, however, is not the case; dye manufacturers may also lend a helping hand. If direct dyes are classified according to their property of yielding equal shades on unequally mercerised cotton it is found that some dyes are distinctly better than others. In other words, unequally mercerised cotton fabric appears more faulty (uneven) in certain shades and less faulty in others. Such differences are, of course, independent of the conditions of dyeing. It would therefore appear probable that certain dyes, already available or yet to be produced, will be especially suitable for dyers of mercerised goods. This is a problem for dye makers as well as the users of dyes.

The task of discovering even-dyeing dyes for mercerised cotton is somewhat similar to that which has recently confronted dyers of cellulose artificial silks. The existence of uneven grades of viscose silk proved a great difficulty to dyers until a reasonably wide range of dyes was found which had the property of dyeing uneven grades in level shades. Regarded

from this standpoint the use and selection of dyes for mercerised materials has a hitherto unsuspected interest.

Investigations along the lines suggested above will be partly dependent on the reasons assigned by the researcher for the increased affinity of mercerised cotton dyes. Is the increased affinity due to physical changes in the cotton fibres or to chemical effects produced by the caustic mercerising liquor? It is, of course, recognised that when cotton fabrics are mercerised they suffer a loss of cellulose, the dissolved portion of cellulose being different from the insoluble residue. Is the increased dyeing power of mercerised cotton due to the removal of this alkali soluble cellulose? Alternatively, is it due to changes produced in the cellulose molecule whereby the mercerised cotton is changed chemically and thereby has an increased power to combine with direct dyes? On the other hand, the mercerised cotton may be more porous and its dyeing properties affected for this physical reason only.

No evidence is available to answer these questions conclusively one way or the other. The writer believes that increased porosity is the fundamental reason, yet it cannot be denied that mercerised cotton has a decreased affinity for basic dyes. The latter fact strongly suggests that the chemical properties of cotton are affected by mercerisation—that the cellulose molecule becomes more acidic.

Several facts could be given indicating that mercerised cotton is more porous than non-mercerised cotton. But if this be granted then an explanation of the increased dyeing power of cotton becomes possible. The dyeing of cotton with direct dyes is most probably a case of adsorption of one solid by another, and the most important factor in such a phenomena is the extent of the adsorbing surface. If mercerised cotton has increased porosity it has a larger surface area than non-mercerised cotton and therefore absorbs a larger proportion of dye and attains a deeper shade.

If the chemical theory be favoured, then search will be made for dyes which have both basic and direct dyeing properties, that is, feebly basic dyes capable of being used as substantive dyes. Remembering that mercerised cotton has a decreased affinity for basic dyes and an increased affinity for direct dyes, it becomes evident why such dyes having dual properties should effectively cover unequally mercerised fibres.

On the other hand, if the porosity theory appears more feasible, then attention will be directed to that type of dye which is absorbed by cotton very rapidly. Such a type of dye will be less affected by the porous state of the cotton fibres than one which dyes slowly and penetrates with difficulty.

Attention may now be directed to oxidised cotton. It is occasionally the unfortunate experience of cotton bleachers to produce tendered goods, and it is found that the tendered portions invariably have a decreased affinity for direct dyes. The tendering may be produced for various reasons; kier burning, excessive strength of bleaching liquor, or contact of the hot fabric with metallic surfaces are among the cause of tendering. Frequently the tendered portions are stated to contain oxycellulose, but this really conveys little information of a helpful character.

Fabric containing irregular patches of oxidised cotton are extremely difficult to dye evenly. It may be suggested that the dyer should modify his dyeing methods, but in turn the dyer is entitled to ask for some contribution from the dye maker. Is it not possible to produce dyes capable of dyeing normal and oxidised cottons equally?

When direct dyes are examined and classified according to their ability to cover oxidised cotton they are all found to be included in one class—that class which resists oxidised cotton strongly. It therefore appears reasonable to expect little help from direct dyes. On the other hand, oxidised cotton has an increased affinity for basic dyes, so that there again arises a need for basic direct dyes. The alternative of using a mixture of direct and basic dyes in the same dye bath is, of course, impossible, since in most instances these two types of dyes precipitate each other.

It is stated that fabrics containing oxidised cellulose may be rendered even-dyeing by treatment with caustic alkalis. This statement is probably based on the knowledge that oxidised cellulose is chemically affected by caustic alkalis, one portion being dissolved. But in actual works practice it is seldom found that a caustic boil does cure the trouble. The fact, however, that oxidised cotton is chemically changed by treatment with alkalis does suggest that in searching for dyes suitable for covering such defects, both oxidised cotton and alkali treated oxidised cotton should be considered.

Knecht and Thompson (*Journ. Soc. Dyers and Col.*, 1920, xxxvi, 251) have made some very valuable investigations of oxidised cellulose, and they indicate some important properties of this substance or substances of value to those endeavouring to produce suitable dyes. Oxidised cotton has considerable reducing power, this being shown by the fact that caustic soda in the presence of oxidised cellulose easily reduces sodium ferricyanide to ferrocyanide, and ammoniacal solutions of silver salts. When treated with alkalis, however, it undergoes simultaneous reduction and oxidation somewhat similar to that which takes place when caustic soda is added to benzaldehyde, thus:—

$$C_6H_5CHO + 2\ NaOH = C_6H_5COONa + C_6H_5CH_2ONa + H_2O$$

Part of the cotton goes into alkaline solution, so that when this is acidified, a precipitate of acidic cellulose is obtained. This acid cellulose has but slight reducing properties and a strong affinity for basic dyes such as Methylene Blue. On the other hand, the alkali-insoluble residue has no reducing power but an affinity for Methylene Blue. The action of caustic soda on oxidised cellulose therefore consists of removing an acidic portion and simultaneously lowering the reducing power of the residue. It was significantly found that Chrysophenine, a dye not affected by reducing agents, has an affinity for oxidised cotton, thus being distinguished by the majority of direct dyes. In searching for dyes capable of dyeing normal and oxidised cotton equally the point should not be overlooked that success may be more easily attained if alkali-treated oxidised cotton is considered instead of untreated oxidised cotton.

Another dyeing difficulty is concerned with the colouring of fabrics containing cottons of different growth, or containing immature or dead fibres. It sometimes occurs that in the dyeing of cotton fabrics distinct changes of shade are noticed in the form of weft bars. Such differences in shade are usually of depth rather than colour and they occur with changes in the weft—that is, with the cop changes. Defects of this type may be due to the mixing of tightly and loose twisted yarns in the same fabric or to the use of yarns prepared from different growths of cotton. Clibbens and Ridge (*Journ. Text. Inst.*, 1925, xvii, 305) have investigated this point. They find that in yarns of 20's count, spun from American cotton, a difference of 4½ turns per inch has a large effect on the resulting shade, while a variation of two turns per inch in yarns twisted from 13–20 turns per inch is distinctly noticeable. Similarly, a variation of three turns per inch in two-fold yarns doubled from Egyptian yarns of 40's count produces a distinct shade in dyeing.

In dyeing various types of cotton, including Sea Island, West Indian, Egyptian, American, and Indian cottons, Clibbens and Ridge also found that the finest types (those of least diameter) dyed to a lighter shade than those of a coarse quality. Thus Sea Island cotton has less affinity for cotton dyes than has American cotton. The dyeing power of cotton fibres is thus closely related to the thickness of their cell walls; the thinner the latter the less the dyeing power. In the extreme case, so-called dead or immature fibres having extremely thin cell walls possess no dyeing power at all. Dead cotton fibres occasionally become attached to cotton yarns used in fabrics, and after dyeing they show up strongly since they fail to absorb the dye and remain white.

The solution of these difficulties may be mainly the task of the dyer, but it may be that, lying in the research laboratory of some dye maker, is a type of compound having an affinity for dead cotton.

The occurrence of bronzy shades when dyeing cotton with basic and sulphur dyes is frequently a source of annoyance to dyers. With basic dyes, bronziness usually appears on the edges or ends of piece goods, whereas sulphur dyed materials are often bronzed all over. It is of interest to know the cause of this phenomenon, but, of course, more important to have a method of correcting it. There is strong evidence to show that a bronzed appearance is due to the presence on the surface of the dyed material of loose particles of dye. Dyes which yield bronzy shades are sometimes observed to have a bronzy appearance when in powdered form. Perhaps the

appearance of a fabric having much loose surface colour is bronzy because most of the light coming from it is reflected from the surface of the dye particles as distinct from that which has penetrated the surface of a dyed fibre and then been reflected. However this may be, there is urgent need for dyes which do not suffer from this defect.

Bronzed selvedges are often noticed in dyeing fabrics with Victoria Blue B. It is known that selvedges, owing to weaving, are usually more resistant to penetration by dye liquors than the remainder of the fabric. Is the bronzing due to this? On the other hand, does atmospheric oxygen play a part? There is no doubt that batches of fabric which do not run true in the dye jig show bronzy edges more than those which run correctly and leave no edges exposed to the air. But this does not prove that oxidation plays a part; it may merely indicate that where dye liquor is not well pressed out of the selvedges there is ample opportunity for the accumulation of loose colour.

Recently Koox (*Textilber.*, 1926, vii, 943) has described a method of dyeing basic dyes whereby bronziness may be avoided. In the method recommended, a certain amount of gelatinised potato starch is added to the dye bath and the resulting dyed fabric is afterwards treated with a desizing liquor capable of removing the starch—for example, a solution of Diastafor. Does the presence of the starch and its removal ensure the removal of loose surface colour, or does it prevent oxidising processes which would give rise to bronziness?

A common treatment for removing the bronziness of sulphur dyed materials is to further treat them with a dilute warm solution of sodium sulphide. This treatment would appear to remove surface colour, and indeed it is probable that all bronziness of sulphur dyes is due to this precipitation of dye particles on the surface of the dyed material.

But since not all basic or sulphur dyes are prone to yield bronzy shades, it obviously becomes the dye makers' task to produce new dyes free from this defect and of such shade and satisfactory fastness properties that they may be used instead of those defective dyes which dyers are obliged to use at the present time.

In conclusion, reference will be made to the dyeing of cotton materials containing regenerated cellulose either in the form of artificial silk or as a filling. It appears quite likely that methods for finishing cotton materials in which cellulose is deposited within the fibres will gain in importance. But regenerated cellulose usually has a stronger affinity for direct dyes than ordinary cotton. Hence the difficulty of dyeing such materials so that the cotton is dyed to a depth of shade at least equal to that of the cellulose filling or artificial silk. This difficulty is, in fact, being experienced now in the dyeing of cotton+viscose silk union materials. At the moment the solution of this problem is found in the case of some shades by modifications in the conditions of dyeing. But dyers do not wish to be hampered by restrictions of dyeing conditions. Rather do they desire to be able to use dyes under conditions acceptable to themselves. Dye makers have thus before them the further task of providing dyes having equal affinities for cotton and cellulose artificial silks or fillings.

At the moment attempts are being made to obtain special finishes on textile materials by means of synthetic resins. No doubt they will in due course be successful, and another dyeing difficulty will be introduced. But there is no point in meeting troubles before they are here.

Courtaulds' Progress

In the course of their report for 1926 Courtaulds, Ltd., state that the equipment of their Wolverhampton factory was virtually finished last summer, though up to the present business has warranted the starting of only part of the plant. Their Canadian factory has run nearly twelve months at full output, while the Soie Artificielle de Calais S.A., has almost completed its building and will be ready during the summer.

Increase in I.G. Employees

The number of men employed by the Dye Trust in the Leuna Works, near Merseburg, has increased since last autumn from 14,000 to 29,200. The staff employed on building work for the enlargement of the works has grown from 1,800 to 12,500.

Chemical Control of Bleaching

Paper by Dr. Clibbens

A joint meeting of the Manchester and Liverpool Sections of the Society of Chemical Industry was held at the Textile Institute, Manchester, on Friday, March 4, Mr. L. Guy Radcliffe, the chairman of the Manchester Section, presiding. The meeting was preceded by a visit to the Shirley Institute, Didsbury, Manchester, by the courtesy of the British Cotton Industry Research Association. A paper entitled: "Chemical Control in the Cotton Bleaching Industry" was read by Dr. D. A. Clibbens, B.Sc., Ph.D.

The Object of Bleaching

Dr. Clibbens said that the simplest conception of cotton bleaching was of a process designed to produce pure white material from originally brown or grey raw cotton; actually the process was something very much more intricate and delicate. The practical aims of the bleaching industry were, first of all, the production of pure white cotton which was permanently white in all the conditions under which cotton was stored, and further, to do this without sacrificing any of its other textile qualities. Secondly, it was to produce material in the very best condition for subsequent processing, *i.e.*, printing, dyeing, and finishing. For example, the material must exhibit perfectly definite and predictable behaviour towards all classes of dyestuffs, a condition only fulfilled by efficiently bleached cotton; or again, the material must wet rapidly and uniformly. Thirdly, certain textile qualities known as the finishing qualities were very much influenced by the nature of the bleaching treatment. Among finishing qualities were included the appearance of the cotton, its lustre, its transparency, the feel of the cotton, its harshness, smoothness, softness, and fullness. The quantitative specification of these properties was as yet in its infancy.

Before any complete system of bleaching control could be established it was necessary to isolate every factor which affected the attainment of these objects and quantitatively to specify its effect. This consideration set the proper lines for industrial research into the process. Work along these lines very soon conveyed the conviction of the impossibility of defining the practical aims of bleaching in purely chemical terms. Variations in the structure of a material affected the textile qualities to at least as great an extent as did variations of chemical composition. Raw cotton freed from mechanical impurities contained, apart from its natural moisture content, 90 to 95 per cent. of cellulose and 5 to 10 per cent. of substances other than cellulose, which might, therefore, be termed impurities of cellulose. The bleaching process consisted in treating cotton with hot solutions of dilute mineral acids, and with oxidising agents, nearly always hypochlorite solutions. The effect of this process was to produce a progressive purification of the cellulose, in the sense that it eliminated from the cotton substances other than cellulose. Different bleaching processes differed in the extent or completeness of this purification of the cellulose. Bleaching processes invariably produced a chemical change, however slight, in the properties of the cellulose itself, and different bleaching processes differed in the extent of this chemical modification of the cellulose.

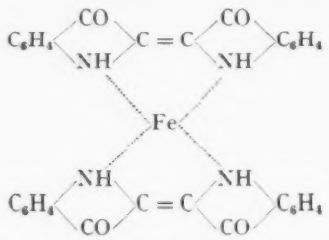
Oxidation of Cellulose

Turning to the oxidising agents, Dr. Clibbens stated that normal pure cotton possessed little or no reducing action under ordinary circumstances. Cotton which had been treated with hypochlorites exhibited, however, to a greater or less extent pronounced reducing action depending upon the conditions of the treatment. This enhanced reducing power could nearly always be detected in commercially bleached cotton. In the same way, treatment of cotton with hypochlorites might increase the acidic properties of the cotton. These changes of increased reducing power and acidity had been ascribed to the formation of a primary oxidation product of cellulose to which the name oxycellulose had been given, but the term was simply an academic cloak of ignorance. It was highly probable that the reducing power and the acidic properties of oxidised cotton were due to a vastly complicated mixture of high physical and chemical complexity.

Dyes and their Application: Recent Technical Progress

By L. J. Hooley

A VERY interesting complex compound of iron with indigo is described by Kunz and Kress in the current issue of the *Berichte*, p. 267. This compound shows some striking analogies with the two very important biological colouring matters, chlorophyll and hæmoglobin. Both of these, it will be remembered, are complex metal compounds, the former containing magnesium and the latter iron. The iron in hæmoglobin is able to absorb oxygen and give it up again with great readiness; it is thus able to act as an oxygen carrier between the air and the physiological system, and it is by virtue of this that hæmoglobin exercises its highly important function in respiration. Although the constitution of the compound is not completely known it is usually formulated as displacing hydrogen from the imino groups of two pyrrol rings and combining with two further rings by residual valencies. Kunz and Kress give their indigo compound a similar structure in this respect. From the representation of its constitution as

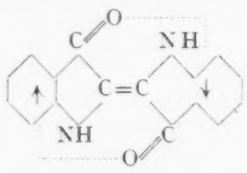


it can be seen that here also the iron is connected to the nitrogen atoms of four pyrrol rings, but by four residual valencies and without replacement of hydrogen. This and similar compounds are obtained by the action of metals or metal acetates on indigo in high-boiling, water-free solvents. The above compound was prepared in pure form from indigo and iron carbonyl in pyridine. It absorbs oxygen with the greatest ease and the oxygen is easily recoverable, as for example, by reduction of pressure, in the same way in which oxyhæmoglobin itself gives up oxygen in vacuum. The first stage in the preparation gives a compound which still contains carbon monoxide and has no power to take up oxygen. This intermediate compound recalls the mechanism of carbon monoxide poisoning, which is explained as due to the combination of the carbon monoxide with the iron, which thus becomes blocked as far as the action of oxygen is concerned.

Although this iron-indigo compound is not a completely satisfactory respiration-model it is of highly suggestive value.

Constitutional Formula of Indigo

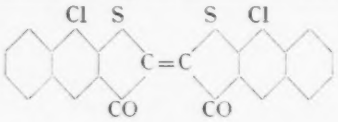
In *Berichte*, 1926, p. 1797, Posner discusses the space formula for indigo and proposes the new formula



This represents indigo as an intramolecular quinhydrone, with residual valencies between the carbonyl oxygen atoms and the opposite benzene nuclei.

Thio-naphthalene Indigos

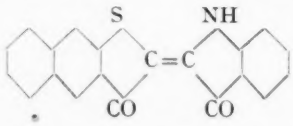
In D.R.P. Application F.53,461 (I.G.F.A.) the synthesis of dichlor-bisthionaphtheneindigo from naphthalene-1-chlor-2-amino-3-carboxylic acid is described. The amino group is replaced by chlorine using the Sandmeyer reaction and the



resulting dichlor body treated with thioglycollic acid. The chlorine in the ortho position to the carboxylic acid is replaced and the resulting thioglycollic acid condensed to the ketodihydrothionaphthene with acetic anhydride. Oxidation to the indigo is carried out with potassium ferricyanide.

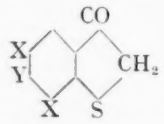
Although this is a thioindigo it is blue in colour and not red, the two extra benzene rings being responsible for the difference. There is an excellent analogy for this in the substituted thioindigos. If two chlorine atoms and two methoxy groups are introduced into thioindigo in the same four positions as those in which the two extra benzene rings are shown attached in the above formula (the two chlorine atoms being uppermost), the resulting compound is violet blue in shade.

If the same compound as that shown above is prepared without the two chlorine atoms the shade is greenish blue, but this is made redder by the chlorine atoms, which effect is again analogous to that obtained by substitution in these positions in thioindigo. This thionaphthene indigo is not new, having been first described in D.R.P. 403,053 (Bayer) starting from naphthalene 1-chlor-2-thioglycollic acid, and it is of interest to note that this body gives the 2 : 3-naphthoxythiophen (benzoketodihydro thio-naphthene) instead of, as would be expected, the 1 : 2 body by replacement of the very reactive chlorine in the 1-position. The dyestuff has also been prepared in D.R.P. 411,652 by direct chlorination. A recent extension of this last-named patent is to be found in D.R.P. Application F. 53,350. The mixed indigos of the 2 : 3-naphthoxythiophen-2-indol-indigo type



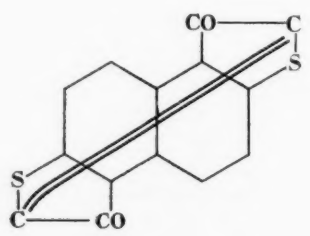
which is halfway between indigo and the compound which has been dealt with above, give blue grey to grey black shades. In the patent under discussion, however, it has been found that blue dyestuffs can also be obtained from these by halogenation, and the products have good fastness to light, chlorine and bowking. This furnishes yet another example of the advantages of the introduction of halogen into indigos.

Products resembling these are described in U.S.P. 1,590,685, but containing a substituted thionaphthene instead of a benzothionaphthene. The thio-naphthenes are of the general formula



where *X* is halogen or alkyl and *Y* is H, halogen or alkyl. Particularly valuable violets are stated to be obtained when the isatin is also halogenated in the 5- and 7-positions.

While dealing with the thio-naphthenes it is interesting to recall the green vat dyestuff of unknown constitution mentioned in D.R.P. 380,712 (Kalle) obtained by



the action of chlor sulphuric acid on 2 : 1 : 6 : 5-naphtho bis-(ketodihydrothiophen) and which Fierz-David suggests is an internal indigo.

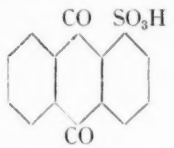
Basic Intermediates for Dyestuffs: No. VII.—The Sulphonic Acids of Anthraquinone

By "Consultant"

ALTHOUGH anthracene and anthraquinone are the raw materials for a vast range of important dyestuffs, very little of these substances is utilised directly for the manufacture of the dyestuffs themselves without first being converted to more reactive intermediates. The majority of these are produced by the aid of the various sulphonic acid derivatives of anthraquinone, which substances therefore constitute a valuable range of dyestuffs intermediates.

The monosulphonic acids.

Of the two theoretically possible monosulphonic acids of anthraquinone only the β-compound can be obtained by simple sulphonation of anthraquinone, even when the strengths of the oleum used and the temperatures at which the batch is heated are varied between very wide limits. The comparatively recent discovery attributed to both Iljinskij and Schmidt that in the presence of a mercuric salt a considerable



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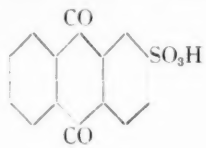

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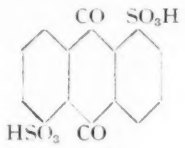
amount of the α-sulphonic acid is formed has been the means of rapid advances in the widening of the range of anthraquinone dyestuffs, since many of the compounds derived from the α-sulphonic acid have greater depth of colour and are more fast to light than the correspondng derivatives of the β-sulphonic acid.

The α-sulphonic acid is prepared in the following way, by the simple sulphonation of anthraquinone. Anthraquinone (1 cwt.) is slowly sifted, in a state of fine subdivision, into oleum (18 per cent., 1½ cwt.) and yellow precipitated mercuric oxide (2 lb.) is added. The mercuric oxide must be very finely powdered and well stirred in before heating is commenced, or else, in the absence of the catalyst, part of the anthraquinone will be sulphonated to the β-acid. The progress of the sulphonation must be watched with care in order to avoid too high a temperature or too prolonged heating, both of which lead also to the formation of the β-acid, which is undesirable, since the two isomers are difficult to separate. In practice the following periods of heating are maintained, stirring vigorously meanwhile. One hour at 50° C. is followed by one hour at 120° C., at which temperature 60 per cent. oleum (¼ cwt.) is added slowly, the addition taking about half an hour. After the addition is completed the batch is stirred for 1½ hours at 120° C. and the slightly cooled liquid poured into a mixture of equal parts of ice and water (14 cwt.). At this stage the unchanged anthraquinone separates out, roughly about 50 per cent. of that used, and has to be filtered off at the presses. If the operations have been conducted precisely as indicated this filtration is often one of particular difficulty since the anthraquinone separates as a slime, which is particularly difficult to handle. It has been found both in the preparation of this substance and of the β-sulphonic acid that if, to the cool sulphonic liquor, water is added at such a rate that the temperature does not exceed 100° C. the anthraquinone separates in a comparatively granular state, rendering filtration easy. Such a process, however, tends to yield a small quantity of the β-acid, thus decreasing the total yield. The filtrate after the separation of anthraquinone is treated with potassium chloride and stirred for several hours at 60° C., during which period the potassium salt of anthraquinone α-sulphonic acid separates out in a crystalline form. The acid itself crystallises in leaflets which are easily soluble in water.

For the preparation of anthraquinone β-sulphonic acid a very similar process is used. Sifted anthraquinone (1 cwt.) is slowly added to 45 per cent. oleum (1 cwt.) and the mixture slowly raised to a temperature of 160° C., at which temperature it is kept for a short period, and then cooled to about 80° C. Water is then added at such a rate that gentle ebullition is maintained. During this latter process anthraquinone to the extent of about 25 per cent. of the initial quantity separates out and is filtered off at the press. The filtrate is about three-eighths neutralised with sodium hydroxide and cooled, when the sodium derivative of anthraquinone β-sulphonic acid ("silver salt") separates out. The filtrate is evaporated *in vacuo* until the gravity (taken hot) reaches 1·18, when on cooling the acid itself separates in a comparatively pure state.

The 1:5 and 1:8 anthraquinone disulphonic acids.

Both of these acids are produced simultaneously during the sulphonation of anthraquinone in the presence of a mer-



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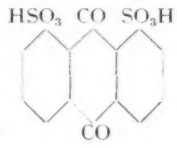

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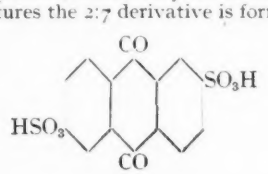
curic salt as a catalyst. There are two main methods for their production. In the first of these a mixture of anthraquinone (1 cwt.), 40 per cent. oleum (2 cwt.) and mercury (1 lb.) is vigorously stirred and heated to 160° C., at which temperature it is maintained for an hour. The mixture is stirred into water (10 cwt.) and neutralised with milk of lime, thus converting the acids into their soluble calcium salts and the excess of sulphuric acid into calcium sulphate. The filtered solution of the salt is concentrated and conversion to the sodium salts effected by the addition of sodium carbonate. After a second filtration, and possibly further evaporation, the liquor is cooled, when the sodium salt of the 1:8 acid separates first. The large middle fraction which separates consists principally of the 1:5 acid.

The second method differs mainly in the method of working up the sulphonic acid liquors. The same mixture as that specified above is heated to 130° C. when a vigorous action takes place, and care is taken that the temperature does not rise above 160° C. Heating is continued until a sample gives a clear solution on dilution with water, by which time all free SO_3 has disappeared. The mixture is cooled and diluted sulphuric acid (78 per cent., 2 cwt.) is added, when the 1:5 acid separates out and may be filtered off on asbestos and washed with diluted acid of the above-mentioned strength. To the filtrate is added half its bulk of water, when the 1:8 acid separates. Either of these acids can be purified by conversion to the potassium salts, which are easily manipulated substances. There is not a great demand for the 1:8 acid, but the 1:5 acid is much used for the preparation of anthrarufin, 1:5-dichlor-anthraquinone, etc.

The 2:6 and 2:7 anthraquinone disulphonic acids.

Both these substances are prepared by a simple sulphonation process, which may be so regulated that at higher temperatures the 2:7 derivative is formed whilst at lower temperatures



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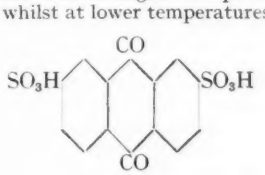

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a preponderance of the 2:6 isomer is obtained. Anthraquinone (1 cwt.) is heated with 45-50 per cent. oleum (2-3 cwt.) to 160° to 170° C. until a sample gives a clear solution on dilution with water. When this stage is reached the mixture

is heated for an hour longer, poured into water and neutralised with sodium hydroxide solution. The filtered liquor is evaporated until the sodium salt of the 2:6 acid commences to separate, when the liquid is cooled and the crop of this substance which separates filtered off. After further evaporation sodium sulphate separates and the mother liquor after the separation of this salt yields the sodium salt of the 2:7 acid on evaporation to dryness. The 2:6 disulphonic acid is utilised for the preparation of flavopurpurin, while the 2:7 acid gives rise to the corresponding anthrapurpurin.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

The improved demand for dyestuffs, which was a feature of our last report, has been maintained during February, with a tendency to fall away a little towards the end of the month. This is probably a temporary setback, because the cotton trade during this period has made considerable progress in many ways. Business is better, the price of cotton futures remains steady, and the Cotton Yarn Association is at last an accomplished fact. The suggestion of a Royal Commission to investigate the cotton trade has received no support from the leaders in the industry, nor from the Manchester Chamber of Commerce, welcome signs of the vigour which alone can bring prosperity to our greatest export trade. A scholarship scheme for young men entering the export trade, auspiciously begun with a donation of £10,000 from Herbert Whitworth, Ltd., the undertaking to establish a statistical bureau by the Manchester Chamber of Commerce and the discussion of a scheme for the setting up of standards for cloths, despite a month of dreary weather and an epidemic of influenza, are all in keeping with the establishment of a very promising state of affairs.

The increasing number of reports on Courtaulds' acetate silk would suggest that the marketing of this product is well advanced. Courtaulds' entry into this field is bound to strengthen the leading position which this country holds in the artificial silk market.

It is understood that the first members of a special series of dyestuffs for viscose silk, discovered by the British Dyestuffs Corporation, Ltd., are to be marketed early in March. It is stated that with these new dyestuffs it is possible to obtain level results on viscose of uneven quality, and if this should prove to be the case the new dyestuffs will receive a very enthusiastic welcome from many harassed dyers. The problem is one which has received the attention of all dyestuff manufacturers for a considerable period and its solution will add greatly to the prestige of the solver.

It is reported that the question of wages has again arisen in the dyeing and finishing trades, but it is hoped that common sense will prevail and that the recovery of the textile industry is not to be further embarrassed by a lock-out or a strike.

Yorkshire

Expected improvement in trade is not yet evident except, it is said, in certain daily newspapers. Indeed, for home consumption of dyestuffs the reverse is being experienced. Export orders received in Yorkshire have helped to keep the works going full time, but margin in such business, if any, is very small. The general state of the textile industry in Huddersfield continues to be patchy, but more workers are being absorbed and trade with Japan is said to be increasing. Brightness of colour and novelty in design appear still to be the popular demand in worsted pieces.

Textile manufacturers in the heavy woollen district are still enduring hard times and their outlook is not hopeful. Here again, bright colour schemes have been found to be the most productive of business. Alderman Ben Turner, General President of the National Union of Textile Workers, at the annual meeting of the Dewsbury Branch, stated that the average time worked by textile operatives during the last four years has been not more than thirty-four hours a week, and that many firms were tottering between life and death. The accounts of the Bradford Dyers' Association, Ltd., for the year to December 31, 1926, were submitted to the Board last month and showed a reduction in profits. Mr. H. R. Armitage has been appointed joint managing director with Mr. George Douglas, who has been sole managing director since 1910. Mr. H. R. Armitage is the son of the late Mr. George Armitage, head of the business of George Armitage, Ltd., dyers and finishers, Water Lane Dyeworks, Bradford. On the formation of the Bradford Dyers' Association the business was absorbed and Mr. H. R. Armitage became a member of the board of directors.

Mr. William Edward Aykroyd, J.P., died on March 1 at the age of 79. He was formerly head of the firm of William Aykroyd and Sons, Ltd., dyers and finishers, Oakwood Works, Thornton Road, Bradford, now a branch of the Bradford Dyers' Association, Ltd.

Benzene continues to decline gradually in price; toluene and xylene are less scarce and sales have been effected at somewhat lower prices. Pure toluene is quoted f.o.r. makers' works at 2s. 4d. per gallon, and pure xylene at 2s. 8d. per gallon. Carbolic acid (crystals) is slightly cheaper at 6d. per lb.

Midlands

February was a very quiet month in the hosiery trade. March does not promise to be any better as far as bulk business is concerned. Most commission dyers are working about half time. Lots are small; consequently output is very low. We tabulate below the position in the principal dye consuming trades.

Wool.—Fancy yarns for pullovers are selling steadily. Woollen hose and half hose are in very moderate request. Knitted fabrics are no better than a month ago.

Cotton.—Sewing cottons are fair. Knitted fabrics are very slow. Lace curtains are quiet.

Artificial Silk.—Panel hose—an important branch—is still very depressed. There is a little inquiry for knitted fabrics for underwear.

Natural Silk Hose.—The small output is still cleared without much difficulty.

Leather.—Chrome upper leathers are not in request, but there is a very fair inquiry for coloured glazed kid for ladies' shoes. Washable glove leathers are selling very well, and there is a steady sale for motor clothing and bookbinding leathers.

Scotland

Dyestuffs sales have not been so good during February, being no better than those for January, although there was a slight improvement towards the end of the month. Prices have, however, remained firm.

There are indications of improvement in the textile industry; some of the company reports for last year now to hand show very satisfactory results, considering the difficulties which have been contended with. The slightly better outlook as the result of these two factors has been reflected in the Stock Market, and there are also slight signs of revival in other branches of industry. These improvements, however, have not yet been felt by the dyestuffs section, which remains much as it was. Conditions continue prosperous in the South, but in other parts of Scotland dyers and printers are not very fully occupied, dyers being generally better off than printers. A certain amount of confidence is still maintained, and it is hoped that the next month or two will provide something for this to work upon. One or two works have been affected by the textile workers' dispute in the Midlands.

The United Turkey Red Co., Glasgow, have announced a dividend for 1926 of 5 per cent., which compares with 10 per cent. for the previous year. A sum of £33,900 has been carried forward as against £39,000, which is a satisfactory result for a very bad year.

The sudden death of Mr. R. D. Hendry (of Patons and Baldwins, of Alloa) has removed an esteemed member from the trade.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.*

Trade in March

THE reports as to dyestuffs trade in March are naturally not uniform, the position varying with local conditions. The general impression, however, on the whole is good, and as the effects of the strike gradually disappear the outlook may continue to improve. The consumption of colours is inevitably largely dependent on the state of the textile industry, and any improvement here is bound to be reflected in the colour industry. The indispensable condition of improvement, which has been emphasised again and again, is industrial peace, and the disturbed conditions in the Far East, usually a big market for Lancashire coloured goods, is a distinctly unfavourable influence. Generally, however, matters are moving forward, if somewhat slowly.

British Dyestuffs Profits

ALTHOUGH the profits of the British Dyestuffs Corporation for the last nine months of 1926 are roughly only one-third of those shown for the year 1925-6, the report for the latter period being the first issued after the reorganisation and reduction of capital, the result must be considered quite satisfactory in view of the abnormal circumstances. To have made during the coal strike period a profit of £82,935, very little below the £88,674 profit shown for 17 months of 1924-5, is sufficient evidence of the remarkable change in the situation effected since the reorganisation. The report simply records an obvious fact in stating that the trading results have been adversely affected by the recent coal strike, which involved not only a substantial increase in manufacturing costs, but led to a reduced demand for the company's products from the big colour-consuming industries. It is stated in the report that 98 per cent. of the shareholders have exchanged their holdings into Imperial Chemical Industries, and the small number who have not are reminded that the offer cannot remain open indefinitely. A dividend of 2½ per cent. per annum is proposed, and shareholders who have exchanged for I.C.I. shares will be entitled to this dividend. The directors who come up for re-election are Lord Ashfield (chairman) and Lord Colwyn (deputy-chairman).

Thionol Brown CL4R.

THE latest addition to the British Dyestuffs Corporation's range of sulphur colours is Thionol Brown CL4R, a colour of a very rich and distinctive character. It is shown on the pattern card in 4 per cent. strength on mercerised cotton yarn, in 8 per cent. strength on cotton fabric, and in 8 per cent. on loose cotton. In contradistinction to the usual light red browns on the market, it is said to possess very good fastness to light, washing, alkalis, acids, and cross-dyeing. In addition, it possesses good fastness to chlorine. The shade is said to be practically unaffected by after-treatment with chrome and copper. The colour is applicable to all forms of cotton materials, and is suitable for dyeing in circulating machines. The full red tone is obtained without after-treatment.

"S.R.A." Blue VII

BRITISH CELANESE, LTD., draw attention to this new addition to their range of "S.R.A." colours for Celanese. The characteristics of "S.R.A." Blue VII are good solubility and yield, greenness of shade (this being the greenest blue dyestuff of the "S.R.A." range), and good all-round fastness properties. Whilst it is not recommended for guaranteed fadeless work, it is nevertheless of a high standard in resistance to light, whilst its fastness properties to acids, alkalis, soaping, ironing, cross dyeing, etc., conform well to the high level of the remainder of the "S.R.A." range of colours. A further quality is that it does not redden at all in artificial light, which makes it very valuable for the production of all types of mode and general shades in which retention of the daylight shade is desirable for artificial light. It is of particular use for the production of navy blues by mixture with other "S.R.A." colours on account of its good yield. For the highest yield, this colour is best dissolved in hot soft water instead of in soap solution, which retards the dyeing somewhat. Where mixing with other "S.R.A." colours for compound shades, they also should be dissolved in a similar manner.

Two samples of delicate Celanese fabric dyed with "S.R.A." Blue VII, a 10 per cent. bath in one case and a 1 per cent. bath in the other, show the colour in full and pale shades almost corresponding with the Oxford and Cambridge blues. The company are prepared to supply to suitable inquirers a free testing sample and any further particulars about the colours that may be desired.

New Dyers' and Colourists' President

DR. HERBERT LEVINSTEIN, who has been unanimously elected president of the Society of Dyers and Colourists in succession to Mr. Ernest Hickson, is too well known in the colour industry to need any description. Latterly he has become closely identified with the artificial silk industry, and with other interests in which chemistry plays a part. In the chair of the Dyers and Colourists he should find congenial work, and be able to do useful work for the industry. Mr. A. Silverwood has been re-elected hon. secretary, Captain J. Denton has been re-appointed hon. treasurer, and Mr. Harold E. Potts has been re-elected hon. patent agent.

Improvements in Dry Cleaning

THE well-known firm of Achille Serre, Ltd., have been experimenting for the last two years with a new continuous filtration process for dealing with the soiled solvent from their dry cleaning machines. The basis of their method is that the solvent is run continuously out of the washer, treated by filtration, and returned in an absolutely clear and dehydrated state for further use in the washing machines. Various other essential features contribute to the excellent results obtained. It is possible to change the liquor in the washing machines some six or eight times for each batch of goods, which can be completely dealt with in ten to twenty minutes according to their class.

One washer charge of solvent will deal with a very large number of loads of goods, and the efficiency of the process is such that it is possible to clean light and dark coloured goods together. "The whole of the dirt from the goods," we are assured, "is caught in the filter, and no further separating or treatment of the dirty solvent is required, except an occasional distillation. Output is improved considerably, and there is a substantial saving in materials and labour. The condition of the goods is cleaner and nearly approaches absolute sterility. The necessary spot-

ting is considerably reduced, and the handle of the cloth is superior. It is also clear that there will be a material reduction in spirit consumption."

First Patent Accepted

THE first patent covering the process has just received the final acceptance of the Patent Office, and provisional protection has been made in respect of the other features which are absolutely essential to the successful commercial working of the process and to obtaining the best results. Patents are being applied for, not only in this country, but in various countries abroad, including Canada and the United States. They cover the application of the process to other industries such as laundry washing and similar operations. The first unit has been in use for the better part of a year and a second improved unit is now being erected. It is proposed, on the completion of final experiments with the new plant, to make the process generally available on a commercial basis. A paper will shortly be prepared for submission to an appropriate society describing the whole process and the theory of dry cleaning on which it is based.

A Plea for Co-operation

MR. R. S. HORSFALL, in an article in *The Times Trade Supplement*, makes a strong plea for closer co-operation between textile, dyestuffs, artificial silk, and other closely allied interests. "The facts," he writes, "seem to be that foreign competition is most keenly felt in the cheaper fabrics made from the older fibres, that the export figures show a rapidly increasing proportion of materials containing artificial silks, that during the coal stoppage the sales of the more modern dyestuffs which necessitate the highest skill in application showed an increase, in contradistinction to the general decrease in other classes. The manufacturer of textures is fortunate to the extent that at this critical time there are in this country well-established manufacturers of every market type of artificial silk and well-established manufacturers of all the most important classes of dyestuffs. The facts given above would suggest that the co-operation of textile, artificial silk, and dyestuff manufacturers represents one of the measures which have met with success; and it is to be anticipated that this success will lead to still closer co-operation and therewith a still further improvement in the general textile position."

Praise for British Chemists

IN his recent lecture before the Royal Society of Arts, Dr. E. F. Armstrong exhibited a number of sample fabrics dyed with rainbow effects by being immersed in and withdrawn from liquid on the surface of which a film of colour had been spread. and the effects were very much admired for their delicacy and variety. This process, the discovery of a B.D.C. chemist, attracts much notice in the American colour journals, which hail this method as a novel and most important advance on the ordinary methods of dyeing. Some of the claims are new to us. For example, it is stated in one journal that the most surprising effects are obtainable with silk stockings: "with a merely slight waviness giving an altered direction the stocking can be so dyed as to make the limb appear either slim or the reverse." Wearers, it would appear, will thus be able to conform to the prevailing fashion of stoutness or slimness without the uncomfortable resort to artificial feeding or artificial starvation. The inventor should become popular with lady customers.

New American Colours

THE dyestuffs department of the du Pont Co. are placing on the market Pontamine Diazo Brown R, which gives a clear white discharge with Sulfoxite C; Sulfanthrene Pink BG paste, especially suited for fast pinks on pure silk; Leucogene W for use in the discharge paste, applied to indigo dyed materials; Ponsol Red AFF, a new vat colour; Pontacyl Red 4R, a new printing paste; and Sulfogene Carbon HXX, a new type of sulphur black. The new Newport colours include Newport Wool Black GRF, particularly designed for the dyeing of closely woven materials. American Aniline Products, Inc., have produced two additions to the series of Amacid Colours—Amacid Fast Yellow 2G, which leaves clear effect threads of cotton and Celanese, while silk threads are dyed, and which is specially adapted to the dyeing of carpets and upholstery; and Amacid Fast Orange LW.

"Fast Dyes"

A BOOKLET on "Fast Dyes" has been issued by the du Pont Dyestuffs Department which may be taken as evidence of the increasing demands for fadeless fabrics, of the fact that the buying public are beginning to understand the meaning of "fastness" applied to the materials they use, and of the growing importance which the textile and dyestuffs industries now attach to this matter.

A.C.S. Dye Section

THE Dye Section of the American Chemical Society has developed into one of the most important in the organisation. At the spring meetings to be held next week at Richmond, Virginia, several papers are to be presented of interest both to users and to manufacturers of dyestuffs. Colonel McMullan, of the Judge Advocate General's Office of the War Department (who will be remembered as the Chairman of the International Commission on Awards to Inventors, which sat for some months at the London Law Courts), will deal with the subject of inventions in the field of organic chemistry and discuss the patent system, Professor W. D. Bancroft, of Cornell University, will speak on "The Theory of Dyeing," Dr. William Mansfield, of the Hygienic Laboratory, will describe his work on "Reversible Oxidation-Reduction in Dye Systems," and there will be contributions dealing with the application of dyes to textile fabrics.

Salesmanship

DR. C. M. STONE, chemical director of E. I. du Pont de Nemours and Co., who had much to do with that great company's entrance into the dyestuff manufacturing industry, has just been discussing the need of co-operation between the salesman and the research chemist. "The alert salesman," he states, "is engaged not only in an effort to sell the goods of his employer, but his continual contact with the trade necessarily gives him a unique opportunity to foresee the general trend of the business, at least in his own line. There are many indications of changing styles and of the gradual growth of new demands. To the discriminating observation of the well-trained salesman these signs along the business trail clearly indicate the direction in which the demands of the trade are likely to go. If the salesman is so fortunate as to be gifted with good judgment and a nice ability to weigh the various factors involved, he is able to present a picture to his technical department which will go far in guiding that department in the development of products adapted to meet specific demands."

"We all appreciate," he adds, "the value of advertising, and we hear a great deal these days about advertising campaigns, but we all know that salesmen have to do a lot of advertising of their own goods. Frequently it is possible for the research chemist to assist the salesman in a more attractive presentation of his goods by giving the salesman, through a complete detailed discussion of the properties of his goods, a more thorough understanding of the value of what he has to sell than the salesman could otherwise obtain."

On Colour Names: The Art of Word-making

By L. J. Hooley

The theme of the article published below deviates somewhat from the beaten track. The fact that it comes from the pen of one whose activities are well known in the field of dyestuff manufacture renders it exceptionally interesting. A suggested scheme of future nomenclature is put forward.

THE number of dyestuffs has now become so large that, if ten names were chosen at random and presented to an experienced colourist, it is doubtful whether he would be able to write down the chemical constitutions of more than two or three. At the same time, such has been the increase in the popular realisation of their importance during the last few years, that if, instead of the choice being made at random, a few of the most familiar and representative were selected, there would probably be found few laymen unacquainted with at least two or three, and fewer chemists who could not remember having at some time heard of them all. As a fairly typical list of familiar names we might take Tyrian Purple, Indigo, Madder, Mauveine, Magenta, Eosin, Fluorescein, Aniline Yellow, Congo Red, Cachou de Laval, Indanthrene, Chlorophyll, and Acriflavine.

The number of commercial dyestuffs may be given as approximately ten thousand. This is roughly one quarter of the number of words in a medium-sized dictionary and largely in excess of an average man's vocabulary. The art of conscious word-making as exemplified in dyestuff names is necessarily distinct from that of chemical nomenclature, for the names have to be acceptable to commerce rather than to science. Whether they should also be acceptable to letters is more debatable. They will often be also trade marks, and part of the technique of making such is the avoidance of the banal. Further, the selective and modifying influence of time, which operates in the growth of common language, is here almost absent, so that a satisfactory name requires some sensitiveness on the part of its author.

Taking dyestuffs, so far as they are known at present, is there any evidence of uniformity or of general tendencies in the formation and selection of names?

The Question of Shades

To begin with, it is evident that there has been no attempt to define colours by differentiating them within fine limits of shade. The dyestuff maker is generally content to use a wide term such as blue or orange. Although this may at first seem a mistake, it is not so in reality, and to think so is to misunderstand the manufacturer's part in this question. If the dyer required the maker to give him an individual product for each of his mode shades, the onus of colour definition might then be considered to lie with the maker. Such an arrangement, however, is quite unfeasible. We could as readily imagine that Turner had demanded from his colourman a separate pigment for every tint on his canvases. So long as the dye maker puts out a sufficient number of straightforward basic shades, the mixer can be left to do the rest, and from the special point of view of colour composition, unnecessary elaboration of shade descriptions only causes confusion.

Leaving the question of shade and coming to that of chemical terms, it can soon be seen that, although a large number of chemical and quasi-chemical words are used, they are not employed either sufficiently generally or accurately to give the impression of being made a basis for dye classification. An exclusively chemical system has already been ruled out as inappropriate for products with a wide commercial use, and, although it might be the most desirable on formal scientific grounds, it would all the same be too complicated for the everyday use even of the chemist, while for others it could not be considered seriously. Imagine the varying pronunciations which dibromoindole and nitrosodimethylaniline would induce. The chemical names which have been incorporated into commercial dyestuffs use will be found to be employed too arbitrarily and to be too simple to be of much significance. Perhaps alizarine and anthracene have been used with more justice than others, although even here they will be found attached to compounds which have no connection with alizarine or anthracene, even if their fastness may approach that of derivatives of these substances.

The third possible framework for name-making is that of dyeing properties and purposes. This is used to about the same extent as the chemical one just dealt with, but much more rationally, for although the examples are very numerous, misuse is here rare. An "acid" colour is found to be an acid colour and not a direct. Theoretically and practically the method has fairly wide but still limited possibilities. For example, the number of colour groups, divided according to use, are small, and when several hundred colours are named "acid" the term loses distinctiveness. "Acid" may be qualified by "acid milling" or "fast acid milling," but, carried too far, a definition is then felt to be taking the place of a name.

We can also examine the question from yet a fourth aspect, that of the manufacturer. The making of the same product by different firms, of course, lends complication to the question and leads to the inconvenience of corresponding substances not being recognisable as such without reference to Schultz or the Colour Index. An individual name for each chemical individual was originally contemplated in the compilation of the Colour Index, but this project was not immediately practicable. The problem of the individual maker has been solved in a large number of cases by the adoption of a special name for each of his series. These names, which are generally trade marks, show one of the most serious attempts which has been made towards the composition of trivial names. This practice is probably tending more than any other factor towards some partial standardisation. Thus Caledon, apart from being indicative of national consciousness, means a vat dyestuff of the anthraquinone series manufactured by Scottish Dyes, Ltd., so that the one word simultaneously serves three different purposes, as well as later by reputation denoting a standard of fastness. Similarly Alizurol stands for an acid alizarine colour of the British Alizarine Co., and the name implies, to those whose practice brings them into familiarity with it, all the known properties of the series it represents.

In these four main bases, colour, chemical constitution, use, and manufacture, we have the principal considerations which have guided the making up of dyestuff names. Derived from these we have an enormous number of what may almost be regarded as roots. Many of these are common words, while probably a large number are partially artificial, being derived from English or other roots which may be roughly grouped as below, where a few examples of each are given.

Chemical: from benzene, toluene, naphthalene, anthracene, aniline, salicyl, gallic; amino, azo, carbo, chloro, oxo, hydro, thio, sulpho, nitro; phenyl, methyl, ethyl; alpha, beta, ortho, meta, para, peri, mono, di, tri, poly, as in Alphanol, Acridine, Benzamine, Chlorazol and Dianil.

Colours: from chryso, cyanos, erythros, flavus, melas, niger, rhodo, ruber, as Chrysoidine, Nigrosine and Rhodamine.

Materials: from lana, erion, as in Lanacyl and Eriochrome.

Makers: from Ciba, Enbico, Erweco, Grela, Irga, Sando, Pon, Aliz, of which examples have already been given.

Places: from Alsace, Buffalo, Nippon, Chokosestsu.

Tendency Towards Systematisation

It is not necessary to give examples other than the above of how these units are combined to give the various series names. In this process we can see a tendency towards some degree of systematisation. Thus in some cases there is analogy between corresponding series by different makers—*e.g.*, Indanthrene, Alizanthrene, Duranthrene (which absorbed the earlier Chloranthrene), Sandothrene, Hydranthrene (since changed to Paradone), and finally Anthrene. Caledon does not fit into this scheme, as being the first anthraquinone vat series made outside Germany, it was established before the vogue for "-anthrene" came into being. One maker may be traced through several series as Duranthrene, Durindone, Durasol, and Duranol; or Ponsol, Pontachrome, Pontacyl,

Pontamine, but perhaps excusably not Pontanthrene; or again Alizarine, Alizanthrene, Alizone, and Alizurol. Sometimes the series name does not appear until several members have been individually named and when perhaps the advantages of uniformity are appreciated better by the increasing difficulty of invention.

Thus Indanthrene once had for its fellows, Flavanthrene, Violanthrene, Cyananthrene, Fuscanthrene, Olivanthrene, Viridanthrene and Melanthrene, all of which are now in process of being forgotten, except Flavanthrene, which remains as the chemical name for the molecule it represents, and for which even Richter did not suggest a systematic name. The Indanthrene colours are now more than a hundred in number, and a brave imagination would have been needed to keep the original naming in line with the first eight, without losing the effect of spontaneity. The magic of Indanthrene has served not only to absorb its own congeners but to displace its Algol and Helindone rivals and thus to unite some two hundred or more different products. In this example the effect of cartelisation of companies is evident, and is also suggestive for the future.

A Suggested Scheme of Nomenclature

In the cases discussed, the nucleus of a possible theoretical scheme can be seen. If for, say, the twenty most important colour groups, twenty labels such as anthrene, anil, acyl, were chosen and to each of these an individual representative symbol as Pon., Dur., Aliz. added for the maker and if further an additional syllable be allowed for important divisions of each group or for different or special methods of application or use, then about sixty different words would give the possibility of eight thousand series names. Then, for the individual colours of a series, about twenty or thirty definite shades could be decided upon as yellow, orange, red, purple, violet, blue, green, brown, grey, and black, with combinations such as orange-red and blue-grey, as well as clearly understandable variations such as gold-orange, olive, maroon, etc., so that about thirty or forty of the commonest and most distinct shades would have an unambiguous description. For special purposes, qualifications such as brilliant, light, dark, fast could also be allowed. Finally with the provision of a number and not more than three letters for a brand, which would also be arranged according to a definite plan, there would be the framework of a system based on about a hundred words, the letters of the alphabet, and the ten digits, which with its capability of forming combinations amounting to millions, should have sufficient elasticity to provide for 90 per cent. of colours. Under this arrangement names would be no longer than at present, each colour would be self-explanatory as to maker, series, and principal use, while with the omission of the manufacturer's syllable, which would be uniformly put first, a colour could be specified as an individual chemical substance independent of its maker.

The recognition of the possibilities of some such plan as the above would be of direct practical advantage when new colours or series come up for consideration. It could act as a curb on unnecessary versatility and there need be no fear of it exercising a deadening influence if worked with a will to the contrary. Significant syllables could be chosen so as to be as distinct as possible from each other and also so that they could be varied to fit in phonetically with contiguous syllables without losing their identity. The infinite variety of artificial words can be seen in cable codes, and the number of units required for a dyestuff system is so small in comparison, that there could be no difficulty in making up words which would satisfy any conditions required of them, aesthetic or utilitarian.

Any considerable alteration in existing names is quite undesirable, for name changing on any scale is always an awkward reform. This difficulty of alteration, however, forms an added reason for doing the best possible with a new name.

Returning, however, from the imaginary to the actual, one of the most distinct features of dyestuff names consists in the additional letters following the name and indicating special marks or brands. Whilst appearing on first acquaintance as an additional vexation, it is sufficient to say in their defence that their use reduces the number of names proper by at least one half, and while they can often be neglected where only a general acquaintance with a colour is necessary, they are of the highest importance to the user for whom they are principally intended. To the dyer in each particular line they often represent differences which he regards for specialised purposes as almost fundamental.

Significance of Brand Letters

Sometimes these brand letters pique the curiosity because their meanings are unknown. As they are only occasionally explained by their authors these must usually be found by guessing, and they are then redolent of secrecy. Most commonly they mark a modification in shade which is too slight to justify fuller expression, as in the very frequent R, red, B, blue, G, yellow (gelb). Degrees of redness in a blue are indicated by an increasing number of R's. These are sometimes large enough to run into two figures, although judicious use should be satisfied by three or at most four repetitions of the same letter. Letters may, however, stand for anything besides shades. There is the P in potting brands of the Diamond Blacks, RRZ (Zucker) for the extra red shade of Indanthrene used in whitening sugar, and SE (Salzecht) for the brands of Saphirole which do not show salt spotting, and examples could easily be multiplied. One of the most useful markings is the K (Kalt) adopted by the I.G. to distinguish their cold dyeing vat colours.

In lettering there is stronger ground than elsewhere for demanding uniformity, and when there is already an established brand on the market, further manufacturers taking up the same product should not haphazardly adopt a different lettering.

Among the earth and mineral pigment colours, brand letters after names are rare. Instead we find ferric oxide under the names Berlin Red, Chinese Red, English Red, Indian Red, Prussian Red, and Venetian Red, the reasons for the variations being easily apparent. It is, indeed, this class of colour which we find richest in distinctive names, perhaps the outcome of more leisured times when colours were brought over the seven seas, and the chemist was also mineralogist and metallurgist. The personal note is found oftener, and a new green brought immortality. Horace Vernet has had even his Christian name brought down to posterity.

One of the happiest examples of individual titles among the coal tar colours is afforded by the acid alizarines brought out by the Bayer Co. and including Saphirole, Irisole, Astrole, Rubinole, Emeraldole, Celestole, Geranole, and Ursol. Here their number is insufficient to cause confusion, the colours merit distinctive names, and their disappearance could only be regretted.

Finally, if it be thought that the systematic has been advocated at the expense of the attractive and the picturesque it may be remembered that among hundreds of plain yellows, blues, and reds we still have Amaranth, Cardinal, Carmine, Cerise, Coralline, Cyclamen, Dahlia, Garnet, Glaucine, Grenadine, Heliotrope, Iris, Jasmine, Mimosa, Opaline, Phloxine, Sepia, and Ultramarine, and we can be grateful for Guernsey Blue, Sky Blue, Glacier Blue, Delphine Blue, Foxglove Blue and Solway Blue, Earth Brown and Chestnut Brown, Jet Black and Corvan Black, Snow White, Mars Red and Kings Yellow.

Dyestuff Licences for March

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during March has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee :—

The total number of applications received during the month was 606, of which 479 were from merchants or importers. To these should be added 10 cases outstanding on February 28, making a total for the month of 616. These were dealt with as follows :—Granted, 542 (of which 518 were dealt with within 7 days of receipt) ; referred to British makers of similar products, 42 (of which 35 were dealt with within 7 days of receipt) ; referred to reparation supplies available, 6 (all dealt with within 2 days of receipt) ; outstanding on March 31, 1927, 26. Of the total of 616 applications received 559 or 91 per cent. were dealt with within 7 days of receipt.

Research Possibilities in Dyestuffs

The Demands of Artificial Silk

Mr. R. S. Horsfall, chief colourist to the British Dyestuffs Corporation, who has often written in the columns of THE CHEMICAL AGE, *contributes an interesting article on the question of dyestuffs for artificial silk to the Artificial Silk Number of "The Times" Trade and Engineering Supplement. Below we give the more important points made in the article.*

FOR the ultimate success of their wares, the artificial silk manufacturer and the dyestuff manufacturer are in common, dependent upon public taste; and taste is a subtle thing, impossible to define. Mere harmony of colour and novelty of design are no guarantee of success; to these must be added sheen, colour, richness, and feel before one can explain the properties which may make a texture appeal and give pleasure to the general mind. Among the many aids to the fabric designer's art, sheen and colour are, without doubt, two of the most valuable. To them the charm of an Eastern carpet, of a field of golden corn rippled by the wind, of a stained glass window, of any landscape in spring or autumn, must largely be ascribed. Combine sheen and colour in a well-designed silk marocain, or a single-hued velvet, and the appeal is irresistible. Yet how easy it is to overstep the mark and to produce something which jars, something in bad taste. If the sheen be too obvious then at once the sense of pleasure disappears. The misuse of colour cannot be better illustrated than by the corruption of the name of the patron saint of colour—St. Audrey—to tawdry.

Inasmuch as the artificial silks are new fibres, and fundamental in their scope, whereas dyestuffs, as the colour producing media, play a relatively superficial *rôle*, the respective influences of the artificial silks and dyestuffs on textures in general differ. It is difficult to estimate the importance of the influences of these two on textures, but if it be assumed that these influences are of equal importance, then the artificial silk manufacturer with relatively few scientific workers has, in some 30 years, with four products, attained a position equal to that attained by the dyestuffs manufacturer with 2,000 homogeneous dyestuffs, after 70 years of research on the part of the most scientific army of workers which has ever been connected with an industry. What might have been accomplished if this army had been employed on the more fundamental problems of new fibres is a matter for conjecture; but the essential fact remains, that with a relatively small expenditure in thought and time, an attack on a fundamental problem has yielded a reward of the same order of magnitude as that achieved by a much greater expenditure on a more superficial matter.

An Army of Workers

Once the textile manufacturer had grasped the possibilities presented to him by the addition of this new fibre to his restricted range of four natural fibres, then the co-operation of a vast army of workers in all industries at all related to the manufacture of textiles was assured. Winding, weaving and dyeing difficulties, sufficient in themselves to ruin the success of anything of less than fundamental importance, have simply served to inspire creative effort on the part of textile manufacturers, dyestuff manufacturers, and dyers, with the result that such difficulties have been largely overcome. Although this extraneous work has been of great value to the manufacturers of the new fibre, it will be understood that it has not been undertaken with any philanthropic motives; it was inevitable, once the various interested industries had come to the conclusion that artificial silk had a future, and therefore that money would be made by the sale of products or skill which might arise through an energetic and intelligent development of the possibilities presented. Naturally the work of development was characterised by many errors of judgment and brought to light many difficult problems. Of the errors none was more remarkable than the name "artificial silk," which was at once an offence against all the rules of good advertising and showed a mistaken view as to the market for the product.

Of the problems which have been solved, or are in process of being solved, may be mentioned: the attainment of regular counts and of regular sheen; the production of fine yarns; sizing, weaving—particularly in conjunction with cotton—and dyeing difficulties. Some solutions have been reached by the natural evolution of the artificial silk manufacturing processes, others by alterations of machinery or methods not designed to meet the peculiar needs of the new fibre. Of the latter it may be interesting to relate the story of the solution by the dyestuff manufacturer of what would appear to have been essentially a problem for the artificial silk manufacturer.

The manufacture of artificial silk by the simultaneous spinning of all the endless filaments which constitute a thread renders impossible the thorough mixing of varying qualities of fibre, which, for instance, takes place in the case of such shorter fibres as cotton or wool. The possibilities of slight variations in the spinning of different batches of viscose with subsequent differences in the rapidity with which dyestuff is absorbed are enormous, and, in fact, are claimed by the manufacturers to be insuperable. In 1920, the late Mr. L. P. Wilson, of Courtaulds, approached Levinstein's (now incorporated in the British Dyestuffs Corporation, Ltd.) with the suggestion that it might be possible to overcome the difficulty by the manufacture of specially designed dyestuffs—the basis for the suggestion being the fact, that whereas most of the direct dyestuffs then on the market were entirely unsatisfactory, a few of them would give fairly even results on widely varying qualities of viscose. Although on the face of it the solution of the problem appeared to lie in finer control of his processes by the artificial silk manufacturer, the suggestion was acted upon. Various lines of attack were attempted, and a few hundred dyestuffs were made and tested before any obvious connection between the chemical constitution of a dyestuff and its dyeing properties on viscose silk was discovered. Interest was kept up on the one hand because the expected solution by the viscose manufacturer did not materialise, and on the other because the rapidly expanding use of viscose silk enormously increased the gravity of the problem. In 1926 a working hypothesis for the manufacture of satisfactory dyestuffs was established, and the first members of a new series of specially designed and patented dyestuffs are now appearing on the market under the general name of "Icyl."

The Cellulose Acetate Problem

Among the problems remaining to be solved are those which arise through physical and chemical weaknesses possessed by the new fibres. Thus we have the swelling and weakening of the viscose thread when wetted, the decomposition with consequent lack of lustre of the cellulose acetate silks when treated with alkaline liquids at any temperature, or even with water above 85° C., and their peculiar dyeing properties which have necessitated the discovery and manufacture of special dyestuffs without value for any other purpose, and therefore somewhat speculative at this stage.

The lack of dyestuffs for cellulose acetate silk has been and still is a very serious problem. The discovery by the British Dyestuffs Corporation, Ltd., that the coloured aminoanthraquinones would dye acetate silk (E.P. 211720) has provided the dyer with the reds, violets, blues, and blacks which were otherwise lacking; but there are several outlets for acetate silk which are entirely closed because of the lack of variety in the properties of the dyestuffs for acetate silk so far placed on the market. It is not possible to claim that dyestuffs with the desired properties are discoverable, but if past experience is any guide and the intuition of those interested in dyestuffs any criterion, then it is certain that they will be forthcoming when the lure of financial gain is sufficiently attractive. The entrance of new manufacturers of acetate silk—with the promise of a more rapid increase in the use of artificial silk, and consequently of a more rapid increase in the quantities of dyestuffs used—is therefore welcomed by the dyestuffs manufacturer, who hopes thereby to secure a more adequate return for money already invested, and also an outlet for his skill in the provision of the much wider range of dyestuffs required.

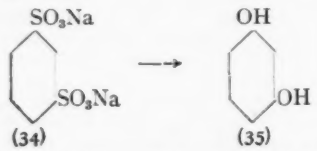
The British dyestuff manufacturer is particularly interested

in a problem of this character, because being entirely new, it enables him to begin on level terms with his much more experienced Continental competitors. That he has taken full advantage of the opportunity is borne out by the fact that he is actually ahead of them as regards the supply of dyestuffs for artificial silks.

Basic Intermediates for Dyestuffs: No. VIII.—Resorcinol

By "Consultant"

RESORCINOL (35) is probably the most important of the simpler dihydric phenols from the point of dyestuffs manufacture, but in spite of the large demand for it, there is only one really important fundamental method for its production—namely, the sulphonation of benzene and the conversion of the *m*-disulphonic acid (34) so



(34) (35)

produced, through its sodium salt, into resorcinol by means of fusion with caustic alkali. Of course, numerous variant processes have been derived and patented from time to time, but there is singularly little divergence from the scheme discussed below. Practically the manufacture may be subdivided into three stages:—(1) Sulphonation to the *m*-disulphonic acid; (2) caustic fusion; and (3) extraction and purification of the final product.

Benzene m-*disulphonic acid*

The manufacture of this substance is of necessity conducted in two stages, since the introduction of the second sulphonic grouping requires a high temperature, incompatible with the volatility of benzene. In the production of the monosulphonic acid, the benzene (1 cwt.) may be heated with 5 cwt. of sulphuric acid (S.G. 1·8) at 80° C., with stirring and the use of a reflux condenser. This method has the advantage of simplicity, but in order to obtain the maximum of efficiency, the methods used in the synthesis of phenol (*vide* THE CHEMICAL AGE, Vol. XV, p. 70) may be employed, viz., the sulphonation of phenol in the vapour phase. If the simpler refluxing and stirring is used the operations on the quantities mentioned takes about 10 hours, by which time the refluxing of benzene will have almost stopped. The second half of the sulphonation, involving the production of the disulphonic acid, proceeds almost entirely to the meta stage, provided temperatures between 200° and 250° C. are maintained. The small quantity of the *p*-disulphonic acid formed at the same time—less than 1 per cent.—is said to be mostly converted into resorcinol and not into hydroquinol on fusion, so that the question of separation of *m*-disulphonic acid from the corresponding para derivative does not arise. The still liquid residue from the monosulphonation is, therefore, run into a large digester fitted with an ordinary condenser, and ground sodium sulphate (1·4 cwt.) added. The temperature is then raised slowly over a period of four hours to 220° to 230° C., at which temperature the whole is maintained for 8 to 10 hours. During the early period of this heating a quantity of benzene which has escaped monosulphonation distils off together with some water.

When cooled somewhat, the reaction liquid is run out into cold water (280 gals.) and neutralised with a paste made from lime (3·3 cwt.). Calcium sulphate is, of course, precipitated whilst the calcium salt of benzene *m*-disulphonic acid remains in solution. As a general rule the liquid is, at this stage, too thick for effective filtration, and, although evaporation costs are thereby increased, it is usual to dilute with water (about 150 gals.) to obtain a filtrable mixture. After filtration, the gypsum is boiled with a small quantity of water to extract any remaining calcium salt, and the filtrate added to the remaining clear liquid, the whole being then evaporated to about half the original volume. The calcium salt is then decomposed by the addition of soda ash (about ¾ to 1 cwt.), and the liquor after removal by filtration of the calcium carbonate is evaporated to dryness. The sodium salt of benzene *m*-disulphonic acid remains as a semi-crystalline powder; about 90 per cent. (3·3 cwt.) is the usual order of the yield.

Caustic fusion

Surprisingly few variations are found in actual practice between the methods of caustic fusion. The caustic soda, together with a little water, is melted in the kettle, which is often directly heated. The exact temperature of fusion is not stated in many patents, but round about 270° C. is the temperature practised in many works. At this temperature the sodium-*m*-benzenedisulphonate reacts fairly rapidly, and produces a hissing sound as added to the hot melt. During fusion the melt is well stirred and fusion is judged to be complete when no further frothing is observed and an oily appearance is seen. The melt may then be poured out into plates and allowed to harden.

Extraction and purification

In the older processes ether was used as the extraction material. The broken residue was dissolved in a fair quantity of warm water (about twice the weight of the melt), acidified with hydrochloric acid, and filtered from any tar which separated. The cool liquid was then extracted with ether in a copper apparatus, arranged on the countercurrent principle. The ether flowed upwards in a series of fine streams through the stirred liquid, and the ethereal layer was constantly being drawn off at the surface, the ether distilled off and returned to the cycle. Such a process proved very wasteful, one pound of ether being lost to each five pounds of resorcinol recovered. The most economical process is to use amyl alcohol for the extraction liquid. The amyl alcohol is quite as efficient as ether as an extractive, and after about four extractions the reaction liquid is exhausted. The alcoholic solution is distilled in steam to remove the alcohol, and the aqueous solution remaining evaporated to dryness. The crude resorcinol is readily purified by a distillation in vacuo, and the overall yield from benzene is about 35 to 40 per cent. Resorcinol finds use as an end component and as a general intermediate in the manufacture of Fast Green, Fluorescein, some of the Congos and the Coomassie Blacks, etc.

Resorcinol derivatives

The Bücherer reaction, which has proved of considerable value in the preparation of various of the naphthylamine sulphonic acid derivatives, has been shown to be of almost equal value in the preparation of aminophenol derivatives, *via* resorcinol. Thus both the parent *m*-aminophenol (36) and its alkyl derivatives—*e.g.*, *m*-diethylaminophenol (37) can be obtained in this manner. The former is obtained by

(36) (37)

heating resorcinol (15 parts) with a mixture of ammonium sulphite (3 parts), ammonium chloride (5 parts) and ammonia (30 parts of a 10 per cent. solution) for 12 to 14 hours at 200° C. in an autoclave, whilst the diethyl derivative is obtained by the use of diethylamine and its sulphite in the same way; *e.g.*, the following mixture has been used:—Resorcinol, 2 cwt.; diethylamine sulphite, 20 cwt. (of the 20 per cent. solution); and diethylamine solution, 3½ cwt. (of the 28 per cent. solution). The free amine is steamed out at the end of the reaction and the liquor acidified, extracted with ether (to remove unchanged resorcinol), neutralised with sodium carbonate, and evaporated until crystals of the base are obtained.

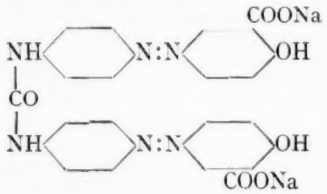
Dyes and Their Application : Recent Technical Progress

By L. J. Hooley

Direct Azo Colours

SOME of the more important developments in the azo chrome and azo development colours have already been discussed. Although these are the azo colours which are attracting most attention at the present time, the substantive ones are too important to be neglected, and new compounds are being regularly described in the patents. The benzidines are, of course, the most important of the direct colours numerically, but the number of the others is very considerable. These others are sometimes divided into sub-groups, such as those containing a diphenyl urea nucleus, those from " J " acid, from naphthylene diamines, and from stilbene derivatives.

The urea linkage is probably always of value in giving affinity for cotton, and the diphenyl urea type, although not very numerous, contains some excellent azo colours, especially some of the Chlorazol and Benzo Fast colours. Among these are the Benzo Fast Yellows. The first one, Cotton Yellow G (Benzo Fast Yellow 5GL, Chlorazol Yellow 5GK), was obtained from diphenyl urea and salicylic acid.



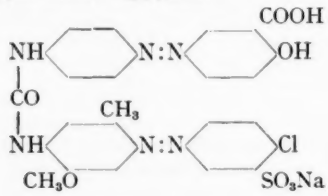
This, one of the fastest of the azo yellows, dates from 1888. Twenty years later even faster products were obtained in corresponding compounds having alkoxy groups ortho to the urea linkage. In Benzo Fast Yellow RL, one of these latter, the two end components are derived from sulphanilic acid instead of salicylic.

Later analogues of these diphenyl urea yellows are to be found in U.S.P. 1,588,934 (Geller). Thus 3-amino-4-methyl benzene-1-sulphonic acid, the terminal constituent, is diazotised and coupled with 4-methoxy-3-amino-1-methyl benzene and the azo body then condensed with phosgene.

Further examples are given in B.P. 245,674 B.A.S.F. While the compounds already mentioned have had either carboxylic or sulphonic acid groups, the ones in this patent have both. They are similar to cotton yellow in not containing alkoxy groups. They may be prepared by : (*a*) Sulphonating ; (*b*) combining a tetrazotised diamino diaryl urea sulphonic acid with a salicylic acid ; (*c*) coupling a diazotised amino sulphonic acid with a salicylic acid and then treating with phosgene.

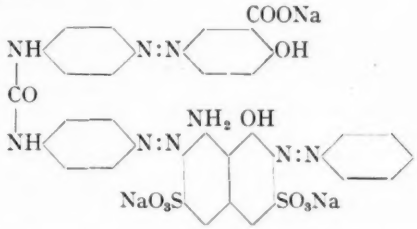
U.S.P. 1,573,605 covers the same ground, but is wider in scope, including the replacement of the urea linkage by an azo or azoxy one. These bodies have excellent solubility, and may be used for both animal and vegetable fibres.

Another yellow of this type, but unsymmetrical, is described (also by Geller) in U.S.P. 1,594,828.



By varying the constituents, shades from greenish yellow to reddish yellow can be obtained. They are discharged white by hydrosulphite.

Instead of coupling two yellow amino azo derivatives by phosgene, one of them may be replaced by a dis- or trisazo derivative. Thus in U.S.P. 1,594,805 (Wenker) one or two molecules of *p*.aminobenzene azo salicylic acid are condensed with 1 molecule of *p*.aminobenzene-2-azo-1-amino-8-naphthol-3.6-disulphonic acid-7-azobenzene. If one molecule of each condenses and the end amino group in the larger constituent is the one which is effective, the resulting compound will be



Removing the urea linkage from this, it will be seen strongly to resemble many green colours produced from benzidine, and to be practically identical with Diamine Green.

Other green dyestuffs, built upon a similar basis but more complicated in structure, are prepared in D.R.P. 419,585 and 420,818 (A.G.F.A. Lange and Neumann). Thus a blue trisazo dyestuff such as 1-amino-benzene 2·5-disulphonic acid-azo-1-amino-naphthalene-7-sulphonic acid-azo-1-amino-naphthalene-azo-2-amino-5-hydroxy naphthalene-1-sulphonic acid is condensed by means of phosgene with the yellow 1-aminobenzene-3-carboxylic acid-azo-2-amino-1-methoxy benzene.

All these urea products are fast to light, but many are not fast to washing.

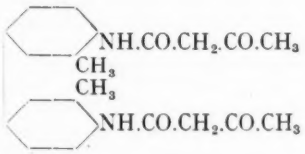
The phosgene condensations are carried out in the normal manner, the dissolved amino bodies being condensed in the presence of sodium carbonate at a temperature such as 50–60° C.

Among recently patented dyestuffs there are also examples of the other sub-classes mentioned at the beginning. Thus products containing " J " acid (naphthalene-2-amino-5-hydroxy-7-sulphonic acid) are obtained in B.P. 248,230, dyeing in blue-green shades.

Benzidine colours, specially suitable for wool and cotton mixtures, are obtained by coupling benzidine with two molecules of " H " acid (naphthalene-1-amino-8-hydroxy-3·6-disulphonic acid) in acid solution and then further coupling with a mono diazo compound and a 1:8 or 1:5 diamino naphthalene (U.S.P. 1,590,042. D.R.P. 423,092 Gr. Laska and Weber).

New Intermediates for Azo Colours

New substituted benzidine derivatives are obtained by heating diamino diaryl bases with acylacetic esters, as, for example, *o*-tolidine and acetoacetic ester (U.S.P. 1,594,864, Zitscher and Schmidt).



Azo dyes are formed from these by coupling diazo compounds with the reactive methylene groups (U.S.P. 1,608,284).

The Society of Chemical Industry, Basle, have described a large number of vat dyestuffs prepared by condensing various anthraquinone derivatives with the triazine nucleus. In Sw.P. 111,123 and 111,497 this nucleus is incorporated into azo colours by combining 2.4.6. tri-*p*-hydroxy naphthyl 1.3.5. triazine with various diazo compounds—*e.g.*, amino-azo bodies. Fast black and bordeaux shades are obtained.

The previously described *p*-hydroxy naphthalene 1-aryl ketones are used for the production of azo dyes in U.S.P. 1,582,029 (de Montmollin and Bonhote).

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

The volume of business done during the month has been of the same order as that of January and February. The first three months of the year have thus been relatively good, but, unfortunately, there are already indications of a decrease, although this may not be serious until May or June.

The British Dyestuffs Corporation's reduced profit of £82,934 was not unexpected in view of the events of last year, but, taking into consideration the returns from the invested cash resources, it must really mean that little or no profit accrued from the manufacture and sale of dyestuffs during the year. There has been renewed activity in the shares of the British Alizarine Co., all of which can be put down to the current belief that sooner or later this company will be taken over by Imperial Chemical Industries, Ltd. Fundamentally the British Alizarine Co. and Imperial Chemical Industries, Ltd., are not competitive, inasmuch as the latter are not manufacturers of alizarine, which is the main product of the former; but it seems scarcely probable that Imperial Chemical Industries, Ltd., will be content to remain outside this important field, and hence the current belief in the eventual union of the two companies.

The second exhibition of British artificial silk goods at Holland Park has had the success which attended the first one, and there would appear to be every prospect of its attaining in its sphere the order of utility and success associated with that excellent institution the Leather Fair.

During the month the cotton trade has been disappointing to such an extent that the Yarn Association has considered it necessary to request its members to close down for a week at Easter. From January until now it is estimated that about 85 per cent. of the spindles have been employed, and it is hoped that the week's stoppage is not a prelude to a return to that soul-destroying policy of organised short time.

Yorkshire

Yorkshire colour makers have experienced a remarkable patchiness in trade this month. The middle brought a briskness of demand for dyestuffs and intermediates that provided at least one company with figures having the appearance of a record for the period commencing with the slump which early succeeded the war. Then came a rapid falling off, to be followed by a good booking of orders for April delivery. Trade of this nature is somewhat characteristic of the month under review, perhaps, because in addition to the holding over by buyers to the new quarter, March 31 marks the termination of the financial year of many businesses, and the month is involved with stocktaking and such-like interruptions. However, a general improvement in trade since the ending of the coal strike has been observed, and taking the whole of March we find the month has maintained the improvement.

Huddersfield cloth appears to be slowly re-establishing itself in overseas markets against foreign competition, even in those countries which have important textile industries of their own, and where quality counts. More activity in the heavy woollen district is attributed more to a demand for urgent delivery for Easter than to larger bulk. The district is less fortunate than Huddersfield with regard to its export trade, and moreover, has to fight in the home markets severe competition in the form of low quality goods from Germany.

There is a good deal of short time in the blanket industry. The trouble which arose from notice given by employers to operative dyers to terminate the existing wage rates agreement is subsiding. Indications suggest that the matter will be argued to a conclusion, and not fought as was originally feared. It is interesting to note that records show that in 1865 for a week of 60 hours the adult male operative wage figure was 20s. Since then, the hours, with one upward fluctuation, have steadily decreased, and the wages increased, until to-day when for a week of 48 hours a wage figure of 56s. 2d. is quoted.

Colour makers and others who bought surplus chemical plant and machinery at the sale by auction held in Leeds on February 23 and following days, referred to in these notes in February, appear to be highly satisfied with their bargains. There are rumours of another sale.

A serious explosion was narrowly averted at Parkgate, near Rotherham, one day last month, when a fire broke out at the South Yorkshire chemical works. The blaze originated in a tank of creosote situated not far from the benzol house, where 4,000 gallons of benzol were being rectified. Huge flames licked the wall of the benzol house and burned out the windows. The efforts of the Rotherham Corporation Fire Brigade prevented the expected explosion.

Benzol, although gradually declining in price, is still appreciably higher than three times the pre-war figure. Perhaps colour users of this country would, if they were to consider this position, be more reasonable in their attitude towards present-day prices of finished British-made dyestuffs. English sodium sulphide makers have given further reductions in their prices.

Midlands

March was the worst month hosiery manufacturers have experienced for years, but there are signs of recovery in some sections. The woollen side of the business does not, however, appear to be improving at all, consequently dyers of cashmere hosiery can work only about two days a week. Woollen fabrics and yarns are almost equally dull.

Sewing cottons continue to sell moderately well, and there is a bettter inquiry for cotton hose, more especially gymnastic and school hose. Lace curtains are slightly better than a month ago. Cotton fabrics for cheap underwear are selling in small volume.

Artificial silk goods for late spring and summer trade are receiving more attention. Knitted fabrics for underwear are in better demand, and artificial silk mixtures for dress goods command more attention. Viscose panel hose seem to be livening up after a long period of depression. Rather more interest is being shown in jumper knitting yarns.

Natural silk and cotton hose continue to sell, and manufacturers report that they are able to clear the present limited output. Many more machines for making silk hose will be operating in the Midlands during the next few months, and it is to be hoped the demand will continue.

Leather manufacturers and merchants are much disappointed with the volume of trade for March, which is much below the average for this time of the year. The only boot leathers that can be operated in with confidence are patent leather and willow calf. Motor clothing leathers sell fairly well, and there is a steady demand for washable glove leathers.

There are no important changes in the prices of dyestuffs to report. Several slight reductions have, however, been made in direct, acid, and basic colours.

Scotland

March has shown some first indications of the much promised and expected improvement. Although conditions have not altered materially, there are now some signs of actual advance; that is, of improvement in fact and not in expectation. The dyestuff sales in Scotland have been rather better than for the last three months, and this is a good sign for the textile industry. The woollen and hosiery trades continue to enjoy the prosperity which has been their good fortune for the last two or three months, and further north, in the Glasgow and Paisley districts, works are rather busier than they have been for some time past, and dyers, finishers, and printers are more fully occupied.

At the first general meeting of Imperial Chemical Industries Sir Alfred Mond stated that revival of trade was taking place and suggested the possibility—given freedom from catastrophes such as that of last year—of a trade year slightly better than normal.

FIVE HUNDRED POUNDS has been left by Dame Mary Louisa Abney, widow of Sir W. de W. Abney, to the Imperial College of Science and Technology to be applied in the furtherance of research in colour vision.

INDIGO EXPORTS from India in January were as follows: to the United Kingdom, 116 cwt.; to Persia and Mesopotamia, 76 cwt.; to Egypt, 19 cwt.; and to other countries, 50 cwt.; total 261 cwt., as compared with 376 cwt. in January, 1926.

Dyestuffs Monthly Supplement

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Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.*

Factors in Dyestuffs Trade

AMONG the fluctuations to which the textile and therefore the dyestuffs industry is subject, it is satisfactory to note the steadily increasing sales of the fastest classes of dyestuffs. This pretty clearly indicates that in the sales of the higher class cotton materials this country is more than holding its own. Dyestuff prices are reported to be fairly steady, but there is talk of pressure being brought to bear on the two-and-a-half times pre-war factor, which at present governs the Dyestuffs Licensing Committee's action in applications to import foreign colours for the British equivalent of which a higher price is charged. The user has often protested that this factor is too high, and the effect on the cost of finished fabrics has been the subject of controversy. In many cases to-day, however, the British price is already below this standard, and the inside view is that a reduction in the factor could only affect the position to a limited extent. Attention is being directed to the slow delivery of dyestuffs ordered from German sources, and this, together with a recent reduction in the number of German brands, rather points to a curtailment of stocks, and may help towards greater stability of prices.

Coricol Finishes for Leather

THE most important of the new samples issued by the British Dyestuffs Corporation is the range of new Coricol Finishes for application to leather. The introduction of Coricol Finishes, following upon the sales of Necol Leather Finishes (formerly marketed by Nobel Chemical Finishes, Ltd.), has been made to meet the demand for grain finishes which have the property of not obscuring the grain, but will assist in the production of even shades of colour on irregular stock, one of the leather dresser's greatest difficulties.

The effect on the leather samples shown is excellent, one sample of chrome calf showing up with great clearness the difference between the treated and untreated parts. Unevenness of colour may be due to the varying nature of separate skins in the same pack, and consequently their different affinities for dyestuffs, and may also be due to variations in texture, even in single skins, which under the best conditions of dyeing, still cause unlevel colouring. In recent years, many pigment finishes or dopes have been introduced which, in a way, overcome these difficulties. These dopes, which as a general rule consist of pigments suspended in casein, albumen, or shellac solutions, cover irregularities of colour, but in so doing mask grain formation. They also possess little or no fastness to damp and rubbing.

Properties of the Finishes

CORICOL Finishes are being introduced to the leather trades in the belief that they possess all the advantages mentioned without the objectionable masking of grain. They are also capable of giving a coloured finish which is absolutely fast to damp and rubbing and at the same time of extreme fastness to light. These qualities are secured by incorporating suitably coloured organic pigments with nitrocellulose varnishes. The fine state of division and the regularity of the size of particles of the pigments used, along with the intensity of colour, enable the Coricol Finishes to cover well without masking of grain surface. Coricol Finishes are intended for application to all classes of grain leather. Even in the case of comparatively thick coatings they interfere little with the feel and appearance of the finished leathers. They are primarily intended for spraying on coloured leathers. Drying is accomplished quickly. After skins treated with Coricol Finishes have been aired for a while, they may be grained, ironed, or lightly glazed.

Ranges of Colours

THE present range of Coricol Finishes includes Coricol Scarlet R, Coricol Yellow G, Coricol Black R, Coricol White, and Coricol Brown A, and two mode shades of Coricol Fawn S and Coricol Fawn O. With these products it is possible to match practically all the shades at present in demand for the shoe trades. Other additions will be made at a later date. These products are viscous liquids which are liable to concentration and loss of properties if stored in open drums or containers. They are best thinned before use by the addition of methylated spirit or such products as Necol Thinner L1663. For general purposes, 1 part of thinner is used with 2 or 3 parts of Coricol Finish. The thinner, especially in the case of methylated spirit, should be added to the Coricol Finish, not *vice versa*.

As to the method of application, skins to be treated with Coricol Finishes are preferably dyed to approximately the shade required. They may be lightly fat-liquored but should be freed from surface grease before being sprayed with the Finishes. Exceptionally greasy skins such as sheep (for clothing purposes) and E.I Goat should be degreased with volatile solvents after being dyed. Where necessary, the clearing of the grain may be accomplished by the use of 5 per cent. to 8 per cent. solutions of ammonia or a mixture of 20 parts lactic acid, 70 parts acetone, and 1,000 parts water. Staking should be accomplished before proceeding with the application of Coricol Finish. It is of utmost importance that all leathers should be perfectly dry before any spraying takes place. Graining and glazing in such cases as glacé goat and willow calf may also precede the application of Coricol Finish.

Several firms supply suitable spraying plants, the usual air pressure for these being 50 lb. per square inch. The skins are tacked or hooked on a vertical board and sprayed with the pistol at a distance of about one foot. Spraying is done from side to side, moving the pistol horizontally at an even distance from the skin. Care should, of course, be taken to ensure a thorough mixing of Coricol Finish and thinner before spraying. In the majority of cases, a light coating of finish is all that is required. The presence of moisture in air supply or colour container should be avoided. After being sprayed, the skins should be hung in a warm dry chamber away from dust and with sufficient room to avoid touching each other. In a current of warm dry air they will dry in a few minutes.

Coricol Finishes are particularly suitable for "tipping" the embossed reptile grain leathers so much in demand at the present time. The Finish, usually black or dark brown, is applied by means of a soft pad to the top of the embossed grain. These finishes give a result which does not bleed or rub off in the subsequent making up of the shoes or fancy goods.

A warning is added that Coricol Finishes are highly inflammable and should be stored in a cool place in tightly sealed containers.

B.D.C. latest Vat Colour

THE latest collection of new colours received from the British Dyestuffs Corporation includes Durindone Scarlet Y Paste, Chlorazol Fast Helio 2RK, Chlorazol Orange PO, Solochrome Brown RH, and Union Black D. Durindone Scarlet Y Paste is an addition to the B.D.C. range of vat colours and is distinguished for its brilliant shade. It is of interest to the calico printing trade, either for direct printing, tannin discharge style or discharging by the Rongalite-Leucotrope process. The colour is applicable to all forms of cotton materials where brilliancy of shade, washing, cross-dyeing and chlorine fastness are required, and is said to be particularly suitable for the dyeing of cotton yarns fast to washing. It is also applicable to wool dyeing where particular fastness to milling is required and possesses the additional advantage of vatting in the presence of ammonia without the addition of caustic soda. Another advantage of the colour is that it is applicable to viscose artificial silk, giving even shades on material of irregular quality.

Two New Chlorazol Colours

THE two Chlorazol colours are also distinguished for their brilliance and are both additions to the B.D.C. range of direct cotton colours. Chlorazol Fast Helio 2RK is a bright reddish violet and is particularly interesting in view of its very good fastness to light coupled with excellent solubility and levelling power. It is designed particularly for dyeing cotton yarn and pieces and works well in circulating machines, although it is equally suitable for all other types of cotton materials. It is suitable for artificial silks on account of its quality of even shades on viscose material of irregular quality; for acetate silk mixtures, the artificial silk being unstained in pale and medium shades; for silk, jute and tagal; while the union dyer will find it of service for covering the cotton at low temperatures in wool-cotton mixtures. Chlorazol Orange PO is applicable to all forms of cotton material, giving bright yellowish-orange shades of good fastness to light, hot-pressing, and washing. It possesses good solubility and affinity and excellent level dyeing properties. It is suitable for dyeing union material of cotton and wool and of silk and cotton. On viscose artificial silk it gives fairly even shades on material of irregular quality. It is suitable for dyeing silk, and also gives shades of good fastness to milling on wool, and in addition it can be used for dyeing jute, tagal, and wood chip.

Other British Colours

SOLOCHROME BROWN RH, an addition to the B.D.C. range of chrome colours, gives full reddish brown shades and possesses the additional advantage of being in powder form. It leaves cotton effects white. It is applicable to the dyeing of all forms of wool materials and in view of its very good fastness to light, good fastness to milling and levelling power, it is specially suitable for dyeing loose wool, slubbing, and piece intended for the manufacture of suitings. In addition it is suitable for dyeing shoddy.

Union Black D is the result of the Corporation's efforts to meet the demand of certain of their customers for a union colour that will produce solid black shades on cotton, wool, silk, and viscose materials. It is stated that the makers have received approval of many garment dyers of a black of this character, and they have accordingly decided to offer this colour generally. Dyeing is conducted in the manner usual for one-bath union colours, at a temperature of about 95° C. and with an addition of 20–30 per cent. Glauber's salt crystals.

From Hickson and Partners we have received a pattern card of their Sulphur Black NRV, which is well known among sulphur blacks for its brightness, depth, and freedom from bronziness. The four samples show the effect of the dye in baths of various strength.

Tar Products Standardisation

THE Standardisation of Tar Products Tests Committee, one of the useful results of the Tar Conference in Manchester last autumn, is a thoroughly representative body, with three excellent officials in Mr. Woolcock as chairman, Dr. E. W. Smith as honorary secretary, and Mr. R. M. Drake as assistant honorary secretary. Already panels have been appointed to determine standardisation tests for crude tar; for pitch, refined tar, and creosote; for the benzol group of substances and pyridine; and for carbolic compounds, naphthalene, anthracene, etc. Further panels are to deal with apparatus, constants, etc., and to arrange for uniformity in terms and units throughout the standard tests. The work is to be welcomed as marking a steady advance in scientific method and tending to secure to the user products of warranted and uniform quality.

Colonial Taste in Colour

MR. J. W. DRIVER, a prominent Bradford textile manufacturer, just returned from a business trip round the world, has been giving some interesting impressions of his tour. The Empire, he is confident, offers an excellent market for West Riding textiles, and everywhere he found a desire to do business with the mother country. On the subject of colour vogue, he states that in Australia green is completely out of favour. "Put green into cloth," he says, "and they will not look at it." The same is true of New Zealand. The favourite shades seem to be vieux-rose and grey; these the Australians love as much as they dread green.

American Dyestuffs Progress

SATISFACTION is expressed in the American press at the present position of the dyestuffs industry. The preliminary report of the Tariff Commission is taken to indicate that the United States makers are increasing their grip on the home market and also exporting increasing quantities in spite of the keen competition of foreign makers. Production of dyes last year increased to the high figure reached in 1920, and was exceeded only by the year 1923. Imports accounted for only 5·2 per cent. of the total production, against 6·2 per cent. for 1925. Remarkable progress in the manufacture of vat dyes, and production for the first time of many dyes of exceptional fastness to light, in a large measure account for the decrease of this percentage. Imports of dyestuffs were made up very largely of high-priced specialities, the very line of products to which domestic makers are now directing their attention. Prices declined as was expected. The weighted average price of all dyes decreased 10 per cent. This, however, is regarded as satisfactory, since the lowering of prices by American manufacturers only makes their position still more secure against foreign invasion.

A Paint and Varnish Remover

MESSRS. M. PHILLIPS and M. J. GOSS, of the U.S.A. Colour Laboratory, have discovered and patented a new process for a paint and varnish remover, according to an announcement authorised by the department, these workers having completed an investigation on the utilisation of para cymene, which comes from an oil obtained as a by-product in making paper pulp from wood. The oil from which the new paint and varnish remover is made was until recently almost wholly an economic waste. It has been variously estimated that from 750,000 to 2,000,000 gallons of this material are annually produced in the sulphite pulp mills of the United States. The paint and varnish remover is prepared by mixing para cymene with grain alcohol, wood alcohol, and acetone, in equal parts by volume. This new paint and varnish remover has been patented by Messrs. Phillips and Goss and dedicated to the people of the United States.

Dyeing Black Shades on Cotton Materials

By A. J. Hall, B.Sc., F.I.C., F.T.I.

Immediately before the war it was estimated that one-half of the world's production of aniline was used for dyeing and printing Aniline Black. Since then the popular taste for bright colours has increased considerably, but in spite of this, the dyeing of black forms an important part of the dyeing trade, while this, in turn, demands from the dye maker a steady supply of black dyes. In the following article will be found much of interest concerning recent developments in dyeing and the production of black dyes.

THE most important methods for dyeing cotton yarns and fabrics in black shades involve the use of direct, developing direct, insoluble azo, vat and sulphur dyes, Aniline Black being perhaps the most important. By themselves, the direct black dyes are not fast to washing, and though they are largely used for hosiery and for the shading of other direct dyes they should not be used for full black shades which are likely to become wetted or be exposed to normal weathering. Whenever possible, materials dyed with black direct dyes should be after-treated either with formaldehyde or by diazotisation and development with a suitable naphthol. Thus Formal Fast Black after-treated with 3 per cent. formaldehyde at 50° C. for about 20 minutes yields a black which has excellent fastness to washing. Similarly Chlorazol Fast Black DV, diazotised with sodium nitrite and hydrochloric acid and then coupled with beta-naphthol or meta phenylene diamine also yields a fast black. But while direct and developed direct black dyes may be used for many purposes, they have not the high fastness qualities of the black shades obtainable by other classes of black dyes.

Sulphur black dyes are particularly valuable for the production of fast black shades. They are cheap and easily applied. Moreover, their fastness to light and washing is generally excellent. It will be remembered that the black dyes were among the earliest sulphur dyes discovered by R. Vidal some thirty-five years ago, who, in efforts to prepare diphenylamine products by heating hydroxy aromatic amines with phosphane, obtained blue and black dyes instead due to the presence of sulphur as an impurity in the phosphane. Sulphur blacks have proved to be the most important dyes in the sulphur range.

Sulphur Blacks and Aniline Black

Sulphur black shades were at one time regarded as a competitor of Aniline Black. The theoretical principles underlying the dyeing of Aniline Black are comparatively simple and known to most dyers. Yet risks (tendering in particular) attending its technical application have led to the dyeing of Aniline Black being concentrated in the hands of a few old-established firms. On the other hand no risk is attached to dyeing with sulphur blacks, and sulphur black dyeing is open to everyone. Unfortunately, it has so far proved impossible to obtain with sulphur dyes a black shade equal to that obtainable with Aniline Black. Sulphur black shades lack depth and when dyed in very heavy shades they have not a pleasing tone. The result is that Aniline Black still remains unsurpassed. But for a large number of purposes sulphur black dyes are satisfactory in every way.

In dyeing sulphur black shades, two faults must be avoided. The dyed material must not be subject to after-tendering, and the shade must not have a bronzy appearance.

The after-tendering of cotton goods dyed with sulphur black is due to partial oxidation of the sulphur dye with formation of sulphuric acid, the last-named substance exerting a tendering action on the cotton. Possibly the oxidation is preceded by a splitting off of sulphur from the dye molecule. In any case it is certain that free sulphur present in the dyed material has little to do with after-tendering. Sulphur black dyed materials may be completely freed from free sulphur by extraction with organic solvents, but after-tendering may occur in the extracted fabric. A few years ago C. M. Whittaker clearly showed that the presence of metals in sulphur black-dyed fabric assisted after-tendering, copper and iron being particularly active in this respect. More recently Kertess (*Melliands Textilberichte*, 1927, 56) has shown that after-soaping or, in fact, any form of after-washing assists after-tendering. The following results obtained with cotton fabric normally dyed sulphur black support this.

Fabric.	Strength after storage allowing after-tendering, per cent.
(*a*) Fabric dyed with sulphur black, normally rinsed in water and dried	50
(*b*) (*a*) impregnated with a solution of sodium acetate and dried	100
(*c*) (*a*) or (*b*) soaped, rinsed with hot distilled water and dried	45
(*d*) (*a*) or (*b*) rinsed four times in cold distilled water and dried	45
(*e*) (*a*) or (*b*) rinsed four times, each ½ hour, in hot distilled water and dried	38

The high tensile strength of the dyed material after impregnation with sodium acetate is obviously due to the neutralisation by this substance of any sulphuric acid formed during storage; it is improbable that it prevents the formation of such acid. The deleterious effect of soaping or washing is probably explained by the fact that such treatment removes all traces of alkaline substances in the dyed material which would neutralise the sulphuric acid formed during storage.

Sulphur black dyeings after-treated with a solution of a bichromate are found to be more resistant to after-tendering. Although this action may be due to pre-oxidation of that sulphur which is likely to become oxidised during storage, this is not likely in view of the fact that the same protection against after-tendering is not obtained by oxidation treatments with other agents such as peroxides. It is more probable that the protective effect is due to the presence of the small quantities of chromium oxide thereby deposited within the fibres.

On the whole, the most satisfactory means for preventing after-tendering during storage consists of so finishing the dyed goods that they contain alkaline substances capable of neutralising any free sulphuric acid which may be formed.

The bronzing of sulphur black shades is most probably due to the deposition on the surface of the dyed material of particles of fully oxidised dye. When cotton piece goods are dyed in a jig, it is usually noticed that if the fabric does not run true, it is the exposed parts such as the selvedges which ultimately appear bronzed. The exposed ends of the pieces also become bronzy. Much the same phenomena occurs when light is transmitted through solutions of Malachite Green and when it is reflected from crystals of the same dye; the transmitted light is green whereas the crystals have a strong bronzed appearance. Thus fabric coated with particles of sulphur dye appears bronzy due to the fact that most of the reflected light is directly reflected from the surface of the dye particles, while much of the light reflected from a fabric free from bronziness contains much light also transmitted through the dyed fibres. Two methods suggest themselves for the removal or prevention of bronziness. In one, the loose colour is removed from the dyed fabric by after-treatment with a warm dilute solution of sodium sulphide or sodium sulphite; if carefully carried out this produces no material change of shade. The other method suggested by Koox (*Melliands Textilberichte*, 1926, 346) consists of preventing the deposition of the loose sulphur dye. For this, a suitable amount of gelatinised starch is added to the dye bath or to the liquor used in brightening the dyed fabric so that when the fabric is afterwards washed, the starch and loose dye particles are removed together. Since in this process the fabric may obtain a somewhat stiffer handle due to retention of starch, this is avoided by the addition of starch liquefying enzymes, for example, Diastafor or Rapidase, to the final washing liquors.

A disadvantage of sulphur black dyes is that they have but small fastness to chlorine. In this respect they are much inferior to vat blacks and that black obtained by coupling Naphthol AS-SW with Fast Black LB base. These latter two types of black dyes may be used for effect threads in cotton

goods which have subsequently to be bleached, and, in fact, Indanthrene Black BB and Caledon Black BB are usually oxidised to their full shade after dyeing by treatment with a solution of bleaching powder. Quite recently, however, two new sulphur blacks—Indocarbon SN and CL—have been introduced which have much superior fastness to chlorine. Indocarbon CL has the greater fastness, and it may be used for dyeing cotton yarns which have subsequently to withstand a mild bleaching treatment. It will be remembered that Aniline Black is also not capable of resisting a drastic chlorine bleaching treatment, so that it should now be possible to use these new sulphur blacks for those purposes in which Aniline Black is now preferable for its greater fastness to chlorine. Indocarbon CL should now be suitable for shirting materials containing black threads or stripes and which in their preparation are subjected to bleaching. Indocarbon CL is also capable of withstanding laundry bleaching processes.

Indocarbon CL is a violet-black, whereas the SN brand is a blue-black. Both blacks have a much decreased susceptibility to after-tendering. The reddish shade of the Indocarbon CL may be corrected by shading with a sulphur yellow or green. Since Indocarbon SN has a very strong affinity for cotton it is not suitable for machine dyeing; the CL brand should be used in these circumstances, since it does not rush on to the fibre. These two new sulphur black dyes represent a material advance in the sulphur dye industry.

Returning now to dyeing with Aniline Black, it will be remembered that dyeing may be carried out in one bath, or by ageing or steaming in a continuous process. The one bath process is used for yarn dyeing, whereas the continuous methods are used for fabric. Both methods depend on the formation of a black pigment by oxidation of aniline and its simultaneous deposition within the fibres of the cotton being dyed. In the one bath process, yarn is suspended in a liquor containing aniline, sulphuric acid, sodium bichromate, and copperas, the liquor being heated sufficiently to ensure the gradual oxidation of the aniline. After dyeing in this manner it is obviously necessary to wash the yarn thoroughly, so as to remove loosely adhering black pigment.

In the continuous methods, cotton fabric is padded with a mixture containing aniline, hydrochloric acid, a metal catalyst such as copper sulphate or chloride, or sodium ferrocyanide, and an oxidant which is nearly always sodium chlorate. The impregnated fabric is then dried at a moderate temperature and passed through a chamber containing a warm moist atmosphere. Afterwards, the fabric, which is green coloured (when copper sulphate is used as a catalyst) or nearly black (when sodium ferrocyanide is used), is further oxidised by passage through a bath of sodium bichromate which may be alkaline or slightly acidic. The principles of these processes were discovered by Lightfoot some sixty-five years ago, although, at the time, the cost of aniline was so high that their technical application was not an economical proposition. Researches since that time have been concerned with the constitution of the black pigment formed within the fibres, and the following stages of formation, first proposed by A. G. Green, are now generally accepted:

$C_6H_5NH_2$ Aniline

↓

$C_6H_5N.C_6H_4:NH$ Caro's Yellow Imide

↓

$C_6H_5.N.C_6H_4:N.C_6H_4.NH.C_6H_4.NH_2$ Willstätter's Blue Imide

↓ oxidation

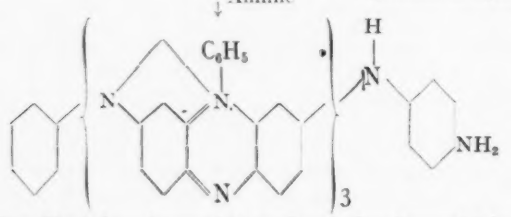
$C_6H_5.N:C_6H_4:N.C_6H_4:N:C_6H_4:NH$ Willstätter's Red Imide

$C_6H_5.N:C_6H_4:N.C_6H_3N:C_6H_3:N.C_6H_4.NH.C_6H_4.NH.C_6H_4.NH.C_6H_4NH_2$ Emeraldine

↓O (present in fabric after drying and slightly ageing)

$C_6H_5.N:C_6H_4:N.C_6H_4.N:C_6H_4.N.C_6H_4.N:C_6H_4:N.C_6H_4.NH.C_6H_4.NH_2$ Nigraniline

Aniline (present in aged fabric)



Aniline Black base (present in aged and afterchromed fabric).

The formulæ above are given fully because it is of interest to note that R. Vidal (*Rev. gen. Teint et Blanchement*, 1926, 1165) has recently shown that the constitution of a sulphur black molecule is very similar, the linkages between the various nuclei being obtained by means of sulphur groups instead of nitrogen atoms. Vidal believes that with this exception the Aniline Black molecule is identical with the molecule of that of a sulphur black dye.

In dyeing with Aniline Black it is essential to avoid tendering of the cotton fabric during drying and ageing. At the moment such tendering has been reduced to within quite small limits so that in this respect Aniline Black dyeing processes may be considered satisfactory. Recently Tschilikin (*Melliands Textilberichte*, 1927, 265) has published some interesting observations on the efficiency of Aniline Black dyeing processes.

It is well known to those who have anything to do with the dyeing of Aniline Black that a considerable amount of aniline escapes during the drying of the padded fabric, thus rendering the process inefficient and at the same time polluting the surrounding atmosphere so that it makes the dyeing process an unhealthy one for the operatives. Tschilikin's experience enables him to conclude that in many processes about 20–25 per cent. of the aniline used escapes unchanged into the atmosphere. This is particularly true of those processes which utilise sodium ferrocyanide as the catalyst and which are known as "prussiate black" processes. With the idea of reducing tendering of the fabric during dyeing it is customary to use in the padding liquor quantities of aniline and hydrochloric acid such that the aniline is in considerable excess. For example, a typical padding liquor consists of:

Aniline oil	80 parts
Hydrochloric acid 35° Tw.	80 parts
Sodium ferrocyanide	50 parts
Sodium chlorate	30 parts
Total volume	1000 parts

This liquor contains an excess of aniline, for 80 parts of aniline are equivalent to 105 parts of hydrochloric acid or, alternatively, 80 parts of hydrochloric acid are equivalent to only 61 parts of aniline.

When fabric is impregnated with the above liquor containing excess of aniline and dried, it loses about 21 per cent. of aniline; under similar conditions it suffers a loss of but 4·6 per cent. when the equivalent quantity of acid (105 parts of hydrochloric acid) is used in the impregnating liquor. It is surprising, however, to find that if the 105 parts of hydrochloric acid are replaced by their equivalent of nitric acid, the resulting loss of aniline is not less than 39 per cent. In either case, whether excess of aniline is used or not, the fabric becomes acid during drying; it is therefore doubted whether the excess of aniline plays any really useful protective part.

The loss of aniline from the impregnated fabric during dyeing is not only dependent on the quantity of acid present, but also on the particular acid employed. It appears that the loss of aniline increases as nitric, tartaric, lactic, or formic acids are used, the loss increasing in the order named. The loss of aniline is also diminished by the addition to the impregnating liquor of a colloidal substance such as gum tragacanth, British gum, or glycerine.

Tschilikin's researches suggest that considerable improvements may be obtained by carrying out investigations along the lines indicated above.

It is important that tests should be available for readily distinguishing between the various black dyes as applied to cotton materials; there are considerable differences in the charges made for the various black shades. Distinction, however, can be fairly readily obtained. Black shades obtained with direct and developed direct dyes are readily permanently destroyed by reduction with sodium hydrosulphite; vat Aniline Black and sulphur dyes are changed in shade but return to their original colour by aerial oxidation. Simple direct shades are much looser to soaping than when after-treated or developed. Sulphur dyes are distinguished by

their ready destruction with a warm solution of bleaching powder (particularly when slightly acidified), and by yielding sulphuretted hydrogen (detectable by filter paper moistened with a solution of lead acetate) when heated with hydrochloric acid and stannous chloride. Aniline Black is not discharged by bleaching solutions under the same conditions as for sulphur dyes, it being merely converted to a brown shade. Further, Naphthol AS-SW black is destroyed by reduction with sodium hydrosulphite but with much more difficulty than the direct dyes. When fabric dyed with this naphthol black is treated with cold concentrated sulphuric acid and diluted, it develops a strong bluish-violet colour; under similar conditions Aniline Black yields a less clear green colour. A vat black resists the above treatments and does not give the colour reactions with sulphuric acid. Using these facts, the identification of a black shade becomes comparatively easy, providing that one black is not topped with another.

Dyeing with Aniline Black is a straightforward economically sound process, suffering from the one disadvantage that the oxidation process requires the presence of acids. Cotton is not deleteriously affected by alkalis, and it would appear that a process is needed having the same character as the Aniline Black process, but in which the oxidation proceeds in an alkaline medium. Then Aniline Black dyeing would be freed from its risks.

Rayon from Cornstalk Cellulose

RAYON has been successfully produced from cornstalk pulp for the first time in the United States by the process of Dr. Bela Dorner, a Hungarian chemist, and after extensive tests by experts has been pronounced practicable and economical, at low cost, and the product has been pronounced superior to the rayon made from wood pulp or cotton, according to C. B. Roberts, president of the Roberts Engineering Co.

He stated that plans are now being prepared for manufacturing plants in the Mid Western corn belt to convert the waste cornstalks into chemical pulp, and that two locations in Illinois are under consideration. The success of this process means that it is possible to convert a waste material into abundant supplies of pulp for making paper, rayon, motion picture films, explosives, celluloid, lacquers, artificial leathers, pyraline, and many other useful products.

"According to the report of the engineers retained to investigate the process, the highest grades of chemical pulp can be made from cornstalks for much less than the same quality of pulp can be produced from wood or cotton," said Mr. Roberts. "This will permit paper to be made from cornstalks on a commercial scale, which has never before been possible. The technical obstacles have been the pith and knuckle of the cornstalk, which could not be removed economically by any process heretofore invented. The Dorner process grinds up the entire stalk. The corn belt destroys annually more than enough cornstalks to supply the pulp requirements of the country."

The chemical end of the investigation was carried out by Dr. John E. Jackson, consulting research chemist, of New York City, who has worked on artificial silk since 1904 and has been consultant for many of the largest pulp, paper and artificial silk companies in Europe and America.

"When I was first asked to check the Dorner process," said Dr. Jackson, "I approached it with extreme scepticism notwithstanding the reputation of Dr. Dorner, who is head of the laboratories of the Royal Hungarian Railways and the inventor of other chemical processes which have been commercially successful. I was familiar with the many obstacles which have stood in the way of utilisation of the cornstalk and the many years of research devoted to the problem. My instructions were to see whether Dr. Dorner had perfected a thoroughly practicable commercial process. I came to the conclusion that he has succeeded. Dr. Dorner worked in closest co-operation with me for several weeks in the plant of the Barrett Company in Elizabethport, N.J., where we demonstrated his process by running 25 batches of cornstalks in quantities sufficient to prove that the process will operate successfully on a commercial scale.

"No one heretofore has been able to convert the cornstalks without first removing the pith and the hard knuckle of the joints. This made the cost prohibitive. The Dorner process uses all the cornstalk. It cuts the stalk into short lengths, washes and grinds it—joints, pith, shell, leaves, and tassel—and carries it through a simple chemical treatment which involves no insurmountable mechanical problems. All of the machinery is standardised equipment. The success is due to the novelty of the method of treatment. It requires from one and a half to two cords of wood to produce a ton of chemical pulp. Three tons of cornstalks will produce a ton of the highest grade chemical pulp under the Dorner process. The cost of gathering three tons of stalks in the corn belt, with a fair price to the farmer, will be well under the present cost of two cords of pulpwood."

Dr. Jackson stated that he had supervised the spinning, twisting, dyeing, and weaving of rayon from the cornstalk pulp produced in the demonstration manufacturing at Elizabethport. He said the fibre had been made by all three of the major processes, and that exhaustive tests have shown it to be superior to the rayon made from wood pulp and equal to and in some respects better than that produced from cotton.

Ordinary chemical pulp contains about 75 to 80 per cent. of pure cellulose. In ordinary papermaking the purity of the pulp is not of primary importance. But in making rayon, lacquers, explosives, celluloids, and other "chemical cellulose products," it is of the utmost importance that the cellulose proportion be as high as possible.

For this reason cotton has been the principal base from which the various chemical cellulose products have been made. Only recently have some of the pulp companies been specialising in the manufacture of a limited quantity of chemical wood pulp attaining as high as 90 to 95 per cent. cellulose content.

Chemical pulp from cornstalks by the Dorner process has been made up to 99·3 per cent. pure cellulose content, and in commercial operation it will produce from 95 to 99 per cent. pure.

Standardisation of Tar Products

Appointment of Tests Committee

As a result of the Tar Conference held in Manchester during November last year, the joint committee of the Institution of Gas Engineers, the Coke Oven Managers' Association, and the Fuel Section of the Society of Chemical Industry has appointed a Standardisation of Tar Products Tests Committee consisting of the following:—Mr. W. G. Adam, Gas Light and Coke Co.; Mr. S. Billbrough, Yorkshire Tar Distillers, Ltd.; Mr. G. B. Brook, British Aluminium Co., Ltd.; Dr. T. Howard Butler, Wm. Butler and Co. (Bristol), Ltd.; Dr. A. F. Campbell, Hardman and Holden, Ltd.; Mr. W. T. Collis, Midland Tar Distillers, Ltd.; Dr. H. G. Coleman; Mr. E. V. Evans, South Metropolitan Gas Co.; Mr. H. Fergusson, Burt, Boulton and Haywood, Ltd.; Mr. C. P. Finn, Coke Oven Managers' Association; Mr. A. G. Francis, Government Laboratory; Mr. G. A. Hebden, South Yorkshire Chemical Works, Ltd.; Mr. H. W. James, South Metropolitan Gas Co.; Mr. J. H. B. Jenkins, London and North Eastern Railway; Mr. J. Macleod, Glasgow Corporation Chemical Works Department; Mr. J. P. Miller, John Miller and Co. (Aberdeen), Ltd.; Mr. H. E. Nickels; Mr. T. F. E. Rhead, City of Birmingham Gas Department; Dr. J. A. Roelofsen, Dorman, Long and Co., Ltd.; Mr. F. S. Sinnatt, Fuel Research Board; Dr. P. E. Spielmann; Mr. G. E. Thomas, Graigola Merthyr Co., Ltd.; and Mr. W. J. U. Woolcock, C.B.E., of the Association of British Chemical Manufacturers.

Mr. Woolcock was asked to take and accepted the chairmanship of the committee; Dr. F. W. Smith and Mr. R. M. Drake were appointed honorary secretary and assistant honorary secretary respectively.

This general committee at its first meeting on April 12 appointed panels to deal with the standardisation of methods of testing tar and tar products as classified below:—A, crude tar; B, pitch, refined tar, and creosote; C, benzole group of substances and pyridine; D, carbolic compounds, naphthalene, anthracene, etc.; and further panels to deal with: X, apparatus, constants, etc.; and Y, editorial (to obtain uniformity in terms and units throughout standard tests).

These panels will report back to the general committee on the work they undertake, and throughout their investigations will work in close collaboration with the British Engineering Standards Association, the American Society for Testing Materials, the Institution of Petroleum Technologists, and other competent bodies. All communications should be addressed to the hon. secretary at 166, Piccadilly, London, W.1.

The Dyeing of Textile Fibres

A Book from a New Angle

In view of the number of developments which have occurred recently in the field of dyestuffs, considerable interest attaches to a new work on The Dyeing of Textile Fibres, *by R. S. Horsfall, M.Sc., and L. G. Lawrie, A.I.C. (pp. 415, 28s.), just published by Ernest Benn, Ltd. A review of the book is given below.*

In the book now under consideration, an effort is made to regard the subject of textile dyeing from an unusual point of view. "Most text books" (states the authors' preface) "attach more importance to dyestuffs than to the materials to be dyed, and, therefore, approach the subject of dyeing the various fibres through descriptions of the various classes of colouring matters. However useful this method may be for purposes of handy reference, we feel that it gives the reader little assistance if he wishes to obtain an understanding of the principles involved; and affords little explanation of the uses, relative importance, and *raison d'être* of the two thousand dyestuffs at present on the market. We have approached the subject from a different angle, namely, from that of the material to be dyed; and by describing either the manufacturing processes which such material still has to undergo, or the final uses to which the dyed material is to be put, we think that a somewhat complex matter has been greatly simplified."

The book opens with an introductory chapter in which a general and historical survey of dyes, dyeing, and colour is made: there are sections dealing with the history of dyeing; a historical review of synthetic dyestuffs; the development of dyeing; colour and light; analysis and measurement of colour; colour blending and the Taylor system of colour harmony; the dyeing process; the fibres; the dyestuffs; the medium; and the theory of dyeing, which latter section deals with the mechanical theory supported by Georgievics and others, the chemical theory, the solid solution theory of O. N. Witt, the colloidal theory, and the electrical theory. Incidentally this chapter contains (p. 9) a statement which, coming as it does from chemists, deserves note. In regard to the explanation of the phenomena underlying the processes of dyeing, the authors say: "It seems clear that the chemist's explanation of many phenomena is no longer tenable, and it is hoped that the physicist's recently-acquired interest in textile matters generally may give rise to the establishment of a working hypothesis within a reasonable period of time."

The Treatment and Dyeing of Cotton

In the next three chapters cotton is dealt with from every aspect, the titles being "The Cotton Fibre," "The Treatment of Cotton Before Dyeing," and "The Dyeing of Cotton." The cotton fibre is considered from the chemical and physical points of view; the action of various agents is reviewed; and an account is given of the immunisation of cotton—its treatment so that it no longer possesses any affinity for direct cotton colours. Singeing, bleaching, and mercerising are dealt with, and finally the question of the actual dyeing of cotton is treated at very considerable length—this being the longest chapter in the book. It opens with an account of the machinery used in dyeing loose cotton, cotton yarn, and cotton pieces. Next comes the question of the choice of dyestuffs, and finally the dyestuffs are considered in detail. They are grouped under the following headings: vat dyestuffs, sulphur dyestuffs, direct dyestuffs, basic dyestuffs, insoluble azo colours, Turkey red, aniline black, and natural colouring matters. In every case profuse practical details regarding the actual application of the dyestuffs, after-treatment, etc., are given.

A short account of the bast fibres—linen (or flax), hemp, ramie or China grass, and jute—in which not only their dyeing but their general treatment is considered, is followed by a chapter on the dyeing of artificial silk. The manufacture, properties, and identification of nitro (Chardonnet) silk, cuprammonium silk, viscose artificial silk, and cellulose-acetate silks are briefly reviewed. The question of uneven dyeing naturally receives some notice. The dyeing of viscose (and the other regenerated celluloses) is described, and in each case lists are given of even-dyeing colours. The dyeing of cellulose acetate silks is, of course, an entirely different matter, and is considered separately.

As in the case of cotton, three chapters are devoted to wool, dealing respectively with the chief characteristics and physical and chemical properties of the wool fibre; the treatment of wool—including shoddy—before dyeing (scouring, carbonising, milling, and bleaching); and finally the actual dyeing. The choice of dyestuffs is considered under the heading of actual colours, *e.g.*, blacks, greys, blues, browns, greens, reds, oranges, and yellows. Slubbing or top dyeing, wool yarn dyeing, and piece dyeing are dealt with at length; and there are sections dealing with materials containing viscose, cotton, or natural silk effect threads; with the application of mordant dyestuffs, in which are considered the chrome mordant process, reduced and unreduced mordant, dyeing on chrome mordant, the after-chrome process, meta-chrome and chromate process, and finally, mordanting processes of lesser importance (chromosol, aluminium, iron, copper, and tin mordants); with the application of direct cotton, basic, and vat dyestuffs to wool; and with sundry finishing processes. The next chapter treats of silk, dealing with physical and chemical properties, degumming, souple silk, bleaching, weighting, and dyeing.

Indigo and Kindred Dyestuffs

The great importance of indigo—still used, as the authors state, to a greater extent than any other single dyestuff—claims a special chapter devoted to it and the kindred products, the Indigosol and Soledon dyestuffs. These latter are water-soluble derivatives, by the use of which it is possible to dye vat dyestuffs on textile fibres without vatting. The application of indigo to wool, the hydrosulphite vat, the application of indigo to cotton, and the fermentation, zinc-lime, and caustic soda-hydrosulphite vats are also considered. That portion of the book which deals with the actual application of dyestuffs is closed by the chapter on the dyeing of union fabrics. The value of this chapter is greatly enhanced by a group of 16 tables of dyestuffs for the treatment of various combinations of fibres.

The rest of the book is occupied with special matters. In an account of the testing and valuation of dyestuffs in the laboratory, details are given to render clear the general methods of procedure. Notes are included on dye trials, affinity, solubility, levelling power, fastness to light, artificial light, and fastness to rubbing; and a lengthy list of fastness tests on cotton and on wool respectively closes the chapter. The question of water next receives treatment. Of this very important matter the authors give an excellent though necessarily condensed account. Some of the points made are of great interest. "It must not, of course, be taken for granted that municipal supplies are necessarily satisfactory for dyeing purposes. Most Yorkshire and Lancashire supplies are excellent, but Leicester has only recently changed its source of supply—and thereby the character—of its water from hard to soft, whilst London water is still hard. In many cases the highly polluted waters of the Yorkshire and Lancashire streams—the shoddies of water—are more desirable, from the dyer's point of view, than are some municipal supplies." A discussion of the objectionable impurities of water is followed by an account of water-softening by the intermittent and continuous lime and soda systems, by the hot process, and by the zeolite or base-exchange method. A chapter is devoted to the various special agents used by the dyer, including protective agents (used for the protection of animal fibres against the injurious action of acids and alkalis); dispersing agents, which possess the power of rendering organic compounds colloidally soluble; and wetting-out agents, which increase the speed of wetting of fibres, powders, etc., and which have been much discussed recently. This chapter includes also a section dealing with organic solvents used by the dyer.

The book closes with notes on chemicals used in the dyeing industry, and sundry tables. A considerable number of chemicals are dealt with (this section covering 24 pages), the authors' intention being to give a brief account of the chief properties and uses of those commercial products in common use in the dyehouse. Among the subjects dealt with in the tables are temperature scales, specific gravities in various denominations, and the specific gravity of various important solutions. There is a classified bibliography dealing with many aspects of textile fibres and their treatment; and there are both general and dyestuff indexes.

Dyes and their Application: Recent Technical Progress

By L. J. Hooley

Colour and Chemical Constitution

ALTHOUGH the classical theory of chromogens, chromophores, and auxochromes of O. N. Witt, along with the quinone theory of Armstrong, and a few rules such as Nietzki's are sufficient to give an intelligible picture of the relations between colour and constitution and to serve as a working basis for predicting the colour of new members of known series, they are known to be only partially correct. The auxochrome-chromophore theory is sometimes a little vague when applied to particular cases, and there are examples of colours without auxochromes and without chromophores, or which are only recognised as containing chromophores by their colour. Armstrong's theory, although inadmissible as the only structural basis for colour, is one of the most attractive that has been proposed, and it is not likely now to be superseded by a better one of the same type.

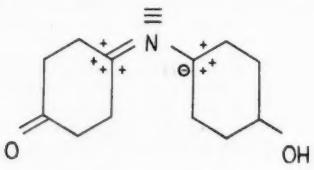
Nietzki's rule that depth of colour is increased by adding groups to give increased molecular weight can show many examples in its support, but generally only holds so long as no considerable change in constitution is taking place.

Quite apart from the questions of their correctness, however, the above, with the partial exception of the quinone theory, do not throw much light on the physical cause of colour or explain the nature of the oscillators which are responsible for the selective absorption of light waves. Although this is one of the most fundamental problems of colour chemistry, it is not accepted whether it is the vibrations of the molecule, the atom, or the electron which are the cause of colour. Naturally under these circumstances colour theory has not been an important factor in the development of dyestuffs.

New Electronic Theory

Where the source of vibration causing colour absorption is ascribed to the electron, the vibrations are normally assumed to involve some kind of transference of the electron from one atom to another. Stieglitz (*J. Fra.klin Inst.*, 1925, 200, 36) considers, however, that the electron vibrates within the confines of the atom and that there is no transference.

Thus in Indophenol, which the author takes as an example,



one half of the molecule being a quinone, is in the condition of an oxidising agent, while the other is analogous to hydroquinone and has corresponding reducing properties.

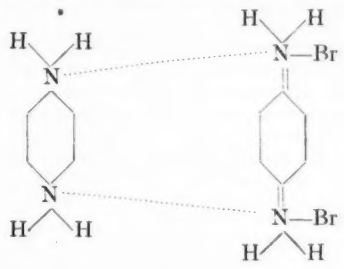
The positive carbon atom on the left of the nitrogen atom has the reducing atom on the right in close proximity. The pair of electrons on the right represented by the negative sign are attracted by the oxidising carbon atom and are loosened from the ordinary intra-atomic restraints by being brought into the outer valence shells, and are thus able to oscillate under the influence of light.

The experimental evidence against actual transference taking place was carried out with derivatives of murexide. A substituted murexide formed from a dimethyluramil and alloxan breaks up again with acid to give the original constituents, whereas if transference had taken place there should have been some dimethyl alloxan formed. With the murexide from uramil and dimethyl alloxan, breaking up again gives the original constituents.

By considering the question from the oxidation-reduction aspect the theory can be extended to inorganic compounds. Thus the black colour of magnetic oxide of iron, Fe_3O_4, which may be regarded as a ferrous ferrite, $FeO \cdot Fe_2O_3$, shows the two oxidising and reducing halves analogous to the hydroquinine and quinone portions of indophenol, and the electronic vibration takes place in the ferrous atom.

Second Order Colours

One of the best illustrations of Nietzki's rule is afforded by the meriquinoid compounds of the quinhydrone type obtained when substances such as *p*-phenylene diamine are partially oxidised. The product from the last mentioned may be



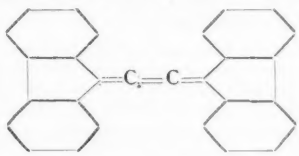
formulated and is yellow. The corresponding compound from diphenyl-*p*-phenylenediamine is blue and from the tetra phenyl derivative is green. If instead of *p*-phenylene diamine, benzidine is taken, the corresponding meriquinoid compound is in each case deeper in colour, until we come to that from tetraphenylbenzidine. The compound from phenyl ene diamine is already green, so that the benzidine colour cannot in this case be any deeper, and it is found instead to be yellow, the least deep of the colours. For cases of this kind Piccard (*Ber.*, 1913, 46, 1843) suggested the explanation that the yellow was due to an entirely different band which had come in from the ultra-violet, the band previously under observation having passed into the infra red. The obvious method of testing this theory, search for the disappearing band in the infra red, has been delayed by the technical difficulties in connection with examination of this part of the spectrum, but Piccard has recently been successful in con firming his own theory in this way (*J. Amer. C. C.*, 1926, 48, 2352). He has even been able to prepare second-order colours as deep as red. Details are reserved for later papers.

Aurin has been found to show no absorption bands in the infra red; its structure cannot therefore be quinonic as originally suggested by Stock $(CH_3)_2N—C_6H_4—C(NH_2)=C_6H_4=N(CH_3)_2$ Cl, as by analogy with the diphenylmethane colours it should then be deeper than blue, and the explanation which has been made, that its yellow shade represents a new band coming from the ultra violet is no longer possible. With the alternative formula $(CH_3)_2N—C_6H_4—C(=NH)—C_6H_4—N(CH_3)_2$, it is merely analogous to a substituted benzophenone, and its yellow colour calls for no comment.

Fulvenes

The fulvenes are of especial interest from the point of view of colour theory. Dimethyl fulvene is yellow and so forms a definite exception to the quinone theory. Also, containing none of the sulphur, nitrogen, or oxygen atoms which most readily lend themselves to the production of unsaturation, the unsaturation responsible in this case must be that between carbon and carbon.

A. A. Vanshaidt (*J. Russ. Phys. Chem. Soc.*, 1926, 58, 39) reviews the fulvene group. The effect of the addition of phenyl groups is to destroy the colour present in the original fulvenes, the redistribution of valency which takes place presumably destroying the colour-producing system in the fulvene molecule. Dibiphenyl ethene, however, is red,



which the author explains as due to the presence of a special chromophore group.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

The dyestuff market generally has tended to become somewhat quieter during April, and this tendency has been accentuated by the Easter holidays. It would appear that the earlier promise of a much better year in the cotton trade is not materialising to the desired extent, although as yet there seems no reason for the pessimistic tone adopted in certain quarters. The remarkable fact that the Mississippi floods have already brought about a serious rise in the price of cotton is an example of the baneful influence of the speculator on the price of the raw material for our most important industry, but should in this instance have acted beneficially on our sales of manufactured material which, according to the rules, should increase on a rising market. Unfortunately, it would appear that the foreign buyer does not agree with the speculator, and is holding off for cheaper prices.

With the pessimism, the familiar stories of material being shipped to the Continent for dyeing and finishing, due to high prices of dyestuffs, dyeing and finishing rings, etc., are here again, and will probably remain with us until the cotton speculator and the buyers of our products have adjusted their divergent views of the Mississippi's spleen.

One constant feature amid the fluctuations, namely, the continuously increasing sales of the fastest classes of dyestuffs, may be interpreted to mean that in the sales of the higher class cotton materials we are more than holding our own, and although it would be rash to assume that such materials can constitute more than a small proportion of the cotton trade, yet every little helps, and the peak of the development is evidently still ahead.

Dyestuff prices remain fairly steady, but under prevailing conditions it is to be expected that pressure will be brought to bear with a view to changing the arrangement of two and a half times pre-war price, which at present governs the Licensing Committee's action in the case of application for license to import foreign dyestuffs for the British equivalent of which a higher price is charged. As, in very many cases, British prices are considerably less already, any reduction in the factor can only affect the position to a limited extent.

During the month a private member's Bill has put into force the recommendation of the departmental committee on the use of preservatives and colouring matters in food. The chief point of interest, so far as dyestuffs is concerned, is the question of the fixing of a maximum content of arsenic and of heavy metals, but it is not at all clear that the Bill achieves this object.

A surprising feature of present conditions is the rapidly growing dissatisfaction with the tardy delivery of dyestuffs ordered from German sources. Slow delivery coupled with a recent announcement of a considerable cut in the number of German brands, suggests a curtailment of stocks dictated by smaller margins of profit, and may thus be an indication of another step along the road to relatively stable prices for dyestuffs.

Yorkshire

After the progressive increasing turnovers of January, February, and March, that of April, notwithstanding the incidence of the Easter Holidays, was decidedly disappointing. The reason of the sudden falling off is difficult to find; it may be observed that the depression was not confined to our industry but was shared with the coal, coke, and metal trades. It is trusted that in order to prevent that most unprofitable spirit, pessimism, raising its head again, May will continue the improvement which March left off.

For some kinds of Huddersfield cloth there is a dearth of orders, but on the other hand makers of cloths which have taken the popular fancy are working overtime on repeat orders. These repeat orders are at about the level of the prices prevailing last autumn. More operatives are being absorbed from the ranks of unemployed. The same could be said before the holidays of the heavy woollen district, but it is uncertain that this happy condition in that district will be maintained.

The dyemakers are naturally relieved to know that the disturbed condition of relationship between the employers and employees of the dyeing and allied trades has subsided. In the absence of a timely settlement 400 dyestuff consuming firms would have been affected.

Coke ovens are slack and consequently demands for benzene, toluene, xylene, and their derivatives, particularly for xylene and its derivatives, are not being easily met. Prices quoted are:—Benzol crude 65's, 1s. 0¾d. to 1s. 1¾d. per gallon; standard motor, 1s. 9d. to 2s. 2d. per gallon, both ex works in tank wagons; toluene, 90 per cent., 1s. 9½d. to 2s. 2d. per gallon; pure, 1s. 11d. to 2s. 4d. per gallon; xylene, 2s. to 2s. 6d. per gallon; creosote, heavy, 8½d. to 9d. per gallon; naphtha, crude, 8½d. to 9d. per gallon, according to quality; solvent, 40/160, 1s. 10d. to 1s. 11d. per gallon, solvent 90/190, 1s. 1½d. to 1s. 4d. per gallon. Carbolic acid crystals continue to increase and are now quoted at 8½d. to 9d. per lb., the demand for export is particularly good and there is some speculation; the maximum and minimum prices during 1926 were respectively 7½d. and 4½d. High prices continue to rule for picric acid, as much as 1s. 3d. per lb. being quoted.

Midlands

The hosiery trade is still very quiet and dyers in all sections are working short hours. The position in various dye-consuming trades is as under:—

Wool.—Hose and half-hose are very quiet; knitted fabrics and fancy yarns are lifeless.

Cotton.—Sewing cottons continue to be the brightest spot. Knitted fabrics are selling in small quantities, but we hear slightly better reports in the cheap garment trade and larger orders are being booked. Cotton hose are not in request excepting a few gymnastic hose; lace curtains may possibly be called a shade better.

Artificial Silk.—There is a better feeling in this important section and several manufacturers are operating more freely; artificial silk fabrics for dresses and underwear are in better demand.

Natural Silk Hose.—There is a steady but healthy expansion in this direction, and there seems no good reason why this should not become an important branch of the hosiery trade in the Midlands.

Leather.—In boot leathers, the best seller is patent; coloured kid in light shades is also in request; chrome uppers and willow calf sell in very small quantities; upholstery and motor clothing leathers are in steady demand; lining leathers are now of no interest to dye consumers, as practically all of it is sold in the natural colour.

Scotland

April was one of the most cheerful months that Scotland has experienced for some time, for conditions were fairly satisfactory throughout. Employment was good and most firms were running on nearly full time. Dyers, finishers, and printers, as well as bleachers, felt the benefit of the slight improvement which took place. While this was perhaps most noticeable around the Glasgow and Paisley districts, it was not confined to that part of the country, although further north and round Dundee business still remained quiet.

At Hawick and the Borders the woollen trade was very satisfactory, having recovered from a very slight temporary set-back of the last few weeks. Most employers have work in hand for several weeks; some repeat orders for the winter season are still coming in. The spring patterns now available have not yet had time to show much in the way of results.

Dyestuffs sales are retaining their good level of last month.

The present time, being almost exactly a year from the beginning of the coal strike, forms a convenient moment for casting a glance at the position with regard to recovery. It is highly satisfactory to note that, speaking of trade generally, employment figures are now barely below the level of a year ago, and that in the textile and dyeing trade such movements as have been noticeable since the beginning of this year have been in the right direction.

Dyestuffs Monthly Supplement

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Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.*

The New Price Factor

THE decision of the Dyestuffs Licensing Committee to reduce the price factor from 2½ times pre-war price to 2 has, of course, attracted considerable attention among manufacturing and consuming interests. Opinions have been received from a number of representative firms, and a selection of these is published on another page of our Dyestuffs Supplement. The matter is also discussed in the leader columns.

Vat Greys and Olives

THE greys in the vat series before the war included Algole Grey B and 2B and Indanthrene Grey B. In addition to these there were Indanthrene Black and 2B, which could be used as greys in pale shades. The Olives were Indanthrene Olive G and Algole Olive R. These were all anthraquinone derivatives. Of the corresponding Indigo colours the most important was Helindone Grey 2B.

At the present time, when all the fastest colours have been collected together under the single name of "Indanthrene," some of these have disappeared; for example, Indanthrene Olive G. This was a sulphur colour. It gave a good fastness to washing and light, but was unsatisfactory as regards chlorine. Indanthrene Grey B has also been removed from the list; this was the old Melanthrene. Algole Grey B and 2B now appear as Indanthrene Grey G and GK, and Helindone Grey 2B, although an Indigo colour, has been brought into the Indanthrene series as Indanthrene Grey 6B; this is a very blue shade of grey. Angole Olive R is now Indanthrene Olive R. In addition, the following new colours have been added:—Indanthrene Grey BTR, RRH, and 3B.

Post-War Products

SINCE the war, corresponding compounds of several of the above have been brought out by British manufacturers in the Duranthrene, Caledon, Alizanthrene, and Paradone series.

The first in each case has been Black B and 2B which can also be used as Greys in pale shades. Black B has always been very popular for greys, but it requires a treatment with chemic to develop the shade, and the exact shade obtained depends upon the severity of the treatment given. In pale shades it has not excellent fastness to light or chemic. The colour is, of course, primarily a black, and as such it is unexceptionable.

To overcome the need for giving a bleaching treatment, several direct dyeing blacks have been brought out, including Cibanone Black B and the Paradone Blacks, any of which can be used either as Greys or Blacks.

Insistent Demand for Greys

AN insistent demand for greys from all quarters of the dyeing trade, both piece dyers and yarn dyers, has, however, shown that the ones on the market still leave something to be desired. Indanthrene Grey RRH, which was probably brought out at any rate partly in answer to this demand, shows very decided improvements over the earlier greys.

Some of the greys which have been brought out have undoubtedly been mixtures. It is, of course, always possible to produce a grey by mixing other colours, but there are extremely few mixtures which will give at all satisfactory results. Greys and olives, being neutral shades, quickly show up any variations, so that differences in the exact methods adopted in dyeing and in the rates of exhaustion of the colours used in the mixture, practically always lead to difficulty in matching the shade. Even apart from this difficulty of reproducing shades, many mixtures do not give homogeneous shades, and the presence of more than one colour can be seen by inspecting a dyeing. Particularly with olives, which are very useful for shading purposes, and for dulling and saddening colours to obtain matches, the levelling property is a most important one, as with only a small quantity of the shading colour being used, it is absolutely essential that this shall distribute itself uniformly.

Four New Caledon Colours

FOUR new Caledon colours have recently been added to the list. The two Olives, 3G and 2B, show a valuable difference in shade from Olive G, as these give greenish and bluish shades of olive, both quite distinct from the other olive. Caledon Grey 3G is bluer than the old Black B and Grey RRH is redder. Both of these dye directly without any bleaching, and have good levelling properties. All four colours give excellent pale shades.

Light tests carried out up to the present show quite remarkably good results, and promise to be equal to Jade Green. If this proves to be the case, they will be distinctly better than the older ones. As has already been mentioned, greys and olives are usually incompletely satisfactory as regards fastness to washing and bleaching, and the main disadvantage of these four new colours is in the same direction. They are consequently of most interest for piece dyeing. For the highest class of yarn dyeing, where a full bleach is employed, the makers do not recommend them. For the same reason they are hardly suitable for dyeing silk, as bleeding will take place in the severe degumming treatments.

The difficulty of obtaining an absolutely satisfactory tertiary shade is perhaps not surprising when the means which have been adopted in their synthesis are examined. Generally speaking, if a chemist wishes to produce a new primary or secondary colour, he will have plenty of possible means at his disposal, such as modifying the number or position of the auxochromes in another known colour so as to lighten or deepen the shade to correspond with what is desired. With a grey shade, however, the position is quite different. A single individual to give a grey shade must be capable of absorbing the three primary constituents of white light at the same time. This necessitates a colour with a complex absorption spectrum, and usually a complicated structure. It is only necessary to remember sulphur black and aniline black to appreciate this point as regards complexity of structure.

New B.D.C. Colours

THREE new colours are announced by the British Dyestuffs Corporation, namely Duranthrene Brilliant Violet 2B Paste, Solochrome Black P.V., and Duranol Brilliant Blue G Paste.

The first-named is an addition to the B.D.C. range of vat colours, and its delicacy is well illustrated on cotton piece and cotton yarn samples. It should be of special

interest to the dyer of wearing and washing materials, embroidery yarns, etc., on account of its shade, its excellent fastness to light, and its very good fastness to washing. It is also said to be of good fastness to hot pressing and water spotting. For calico printing it is also suitable, the prints obtained being of good fastness to washing.

Solochrome Black PV., a new addition to the B.D.C. range of chrome colours, is described as the fastest potting chrome black on the market, and on account of its very good fastness properties should appeal strongly to the dyer of loose wool and slubbing. The samples shown on woollen piece, cotton yarn and on slubbing are distinguished for their soft depth of colour. Owing to its excellent solubility, it is strongly recommended for dyeing in all types of machines. This colour is generally dyed by the after chrome process, but it is also possible to dye it on a chrome mordant.

Duranol Brilliant Blue G Paste is an addition to the B.D.C. range of colours for cellulose-acetate silk, and the samples shown on Celanese piece and Celanese yarn illustrate the brilliant and delicate properties of the colour. It gives very bright blue shades of excellent fastness to light and washing, and is particularly suitable for the dyeing of cotton and cellulose-acetate mixtures, owing to its non-staining property. It can be used in combination with other B.D.C. Duranol and Ionamine colours.

Chlorazol Colours on Cotton Yarn

THE 41-page volume of Chlorazol Colours on Cotton Yarn, issued by the British Dyestuffs Corporation, illustrates the immense range of British colours to be found even in one series. This collection alone contains no fewer than 233 colours, which, even on cotton yarns, are distinguished for their brilliance. The colours are conveniently classified according to their suitability for diazotisation and development, for coupling with diazotised paranitraniline, for tinting, for Celanese resist work, for dyeing cotton effects (burl dyeing) in woollen piece goods, and for working in conjunction with size, while a list of acid colours is given suitable for padding on cotton where extreme brightness of shade is of paramount importance and fastness to water is negligible. The directions for working according to the different processes are simple and comprehensive. The ordinary colours exhibit a wonderful gradation of shades, from the yellows and oranges, through the browns, reds, violets, greens, and blues, to the blacks. Those for tinting are particularly delicate, and those for padding are distinguished for brilliance.

"To Young Weavers"

THOSE who are privileged to get a copy of the address that Mr. James Morton, the head of Scottish Dyes, Ltd., and of Sundour Fabrics, delivered recently to the young weavers of the Textile Institute of Manchester, at their annual distribution of prizes, will be grateful to the author for publishing it, for a more delightful brochure has rarely come into our hands. The colour designs by Charles Paine illustrate the completely satisfying effect with which colour may be utilised—how freedom may be reconciled with restraint, and quaintness indulged without grotesqueness—and the printing by the Baynard Press constitutes craftsmanship of the best. Mr. Morton has a very fine record, firstly as a producer of the well-known Sundour Fabrics, and secondly as a producer of dyestuffs—being forced to enter the latter industry by the cutting off of his former supplies during the war—and the results could only have been achieved by an extremely capable business man. Yet we know some good judges of character who insist that he is above all else an artist, with the artist's feeling, vision, and imagination. And this charming production, in which the author describes "some practical dreams on the future of textiles," is in every feature an artist's work.

"A Coming of Age"

IN his "Foreword," Mr. Morton comments on the coming-of-age of his firm in terms which are well worth reproducing:

I have been reminded that it is now over twenty-one years since our firm, for the first time in the history of the textile trade, put on the market fabrics having in their composition only colours that were fast to light and washing, and which were guaranteed to be replaced if they failed in fastness. This step was taken after a long period of testing and elimination, and we did it as a protest against the notoriously loose and cheap colours that had been the common currency of the textile trade for several decades.

The project was considered bold and venturesome, not to say hazardous. But it was a seed that took root, and the fruits are now visible in most branches of the trade the world over. Indeed, the idea may be said to have redeemed the colour character of textiles, to have established a new standard, and to have made worth while in the industry an effort towards a higher form of artistic expression.

Incidentally, through our firm, it led to the establishing of the first factory in this country for the manufacture of fast dyes, a branch which has so developed that it now employs several hundreds of chemists and chemical workers, and whose dyestuff products are equal in quality to those made in any part of the world.

When I was asked the other day to speak to the young weavers of the Textile Institute of Manchester at their annual distribution of prizes, I tried to indicate uses for these colours in textiles more worthy of their wonderful new value. Friends have been good enough to ask me to print the remarks I then made, and these are now sent out in this form in the hope that they may meet those wishes and at the same time act as a souvenir of the "Coming of Age of Sundour."

A Plea for Craftsmanship

THE purpose of Mr. Morton's pamphlet is to inspire the young weaver with a feeling for his vocation, to make an art of it, to find joy and success in it. And especially does he insist on colour as the power that makes the fibres live and speak, and on "individual high quality work," for which, in spite of modern bulk production, the world will never cease to ask. Quoting the remark, once made of Morris, that he "began to stain his wallpapers with poetry," he applies the moral in this fine passage:—

To equip ourselves we want to dip into the finest old products of the past, not to copy or imitate, for those were produced by methods and under conditions that are no longer ours. But we want to feel what it is in them that has made them live and that make them thrill us to-day like an old song. We are too afraid of ourselves in these times, too self-conscious, too timid of putting anything of ourselves into the things we design or do. Yet that is just the secret of these fine old masterpieces; they are so spontaneous and unconscious. Look at some of the old Peruvian textiles, for example, the fun and drollery in the figures, and the superb colouring. What fun the old weavers must have had in making them, and that fun is in them for us to enjoy to-day. Can we catch something of their spirit? To-day "the world is so full of a number of things" of such infinite variety and interest on which we all have thoughts of our own. Why should not those find expression in the designs and colourings of our fabrics, and so make them modern living things? Why should we be content to continue making copies of old documents that have now lost their meaning for us, when there is so much to say and portray about our own times and surroundings?

One seems to feel in all this the spirit that has moved the author to do the fine things he has done. He has merely written in words the message that was already inherent in his work.

Trade Opinions on the New Dyestuffs Price Factor

Divergent Views of Users and Makers

In response to a request to several dyestuff making and dyestuff consuming concerns, respecting the effect of the new price factor (2 instead of 2½ pre-war), to come into operation on September 1, we have received a number of replies from which the following are selected :—

Mr. H. Sutcliffe Smith

(*Chairman of the Bradford Dyers' Association*)

As a member of the Dyestuffs Advisory Licensing Committee, I am very glad that that body has resolved to apply the principle of the 2-times factor in connection with applications for licences on price grounds. Not only will this reduction be helpful to the colour consuming industries of the country, but I am confident that it will react in favour of the British makers. It is, in fact, indicative of the progress of the British dyemaking industry that their representatives on the Licensing Committee have agreed to the request put forward by the users for a reduction in the factor. It is very definite evidence of the fact that the protection afforded by the Dyestuffs (Import) Regulation Act has been used to considerable advantage by the British makers, and that they are now in a position to meet the request to bring their level of prices more into line with those ruling in the world's markets generally.

This reduction should also bring additional business to British makers, who should now be able to meet foreign competition. Now that the British industry has got on to its feet, users look forward to the time when the restrictions imposed by the Dyestuffs (Import) Regulation Act will be more or less formal and the British industry can meet competition on a strictly economic basis. The contemplated reduction in dyestuffs prices, when it becomes effective, should help to put the using industries in a better competitive position, at any rate, so far as this important item in their costs is concerned.

British Cotton and Wool Dyers' Association

Thanks for your favour in regard to the reduction in the price factor of dyestuffs from 2½ to 2 pre-war prices.

Whilst any reduction is naturally always welcome, the suggested one, per lb. of material dyed, will on the whole be so slight that consumers will be practically unable to make any concession in their processing charges to customers.—A. Hoegger.

L. B. Holliday and Co., Ltd.

Generally speaking, there is not much to be said for discussing purely commercial questions of price in the technical or daily press, but the application of the " factor " to the prices of dyes, whereby home manufacturers must accept, under threat of the granting of an import licence, a price of 2½ times or twice the pre-war price, does lend a wider interest to the subject.

The actual average sale price of our own range of dyestuffs is to-day very much closer to a factor of two than to a factor of two-and-a-half ; and this has been attained in spite of the fact that many of our primary intermediates and raw materials are disproportionately dear.

We have held consistently to the view that the British dyestuffs industry cannot be on sound lines unless and until it can sell at world prices in world markets, and we have proved that it is possible to do this by building up a large export trade in dyestuffs, even under existing circumstances. In our view, the great obstacle is the high level of prices charged in this country for raw materials and many primary intermediates ; the common mineral acids for example costing two or even three times as much as on the Continent.

We believe that these raw material prices can be and ought to be lowered, and if this is done at once, we see no reason why British colour manufacturers should not be able by September 1 to work to a factor of two for their dyes. For our part we have not opposed a reduction of the factor nor placed any obstacle in the way of the reduction which the Dyestuffs Advisory Licensing Committee has now decided upon.

Brotherton and Co., Ltd.

The reduction of the factor from 2½ to twice the pre-war price of dyestuffs may have the effect of retarding the development of the dyestuffs industry in this country. The manufacture of a new dyestuff requires a great amount of preliminary work on the large scale before the process is efficient. All this work is expensive, and the money thus expended can only be recouped if a reasonable margin is obtained from sales.

Again, new colours often require intermediates either not made in this country or made only by one of the other dyestuff makers. If these intermediates are expensive, their use raises the cost of the colours to such a level that a two-times factor will not enable a margin to be obtained.

J. C. Bottomley and Emerson, Ltd.

In our opinion there is no doubt that the reduction of the price factor of dyestuffs from 2½ to 2 will have a very detrimental effect on the development of the industry. Many of the basic raw materials are no cheaper to-day than they were a year ago, and in certain cases it will be economically impossible to produce dyestuffs without loss.

Unless the British manufacturers are prepared to shoulder this loss it will necessarily follow that there will be an increase in foreign imports, and to that extent a displacement of British employment.

Yorkshire Dyeware and Chemical Co., Ltd.

In regard to the decision of the Dyestuffs Licensing Committee to reduce the price factor from 2½ to 2 pre-war price, we do not consider that this decision will affect us in any way, because most of the colouring matters which we are at present selling are already below that limit and nearer to pre-war prices.

A Northern Dyestuffs Firm

Our own feeling about this matter is that the colour users' representatives on the Committee are adopting an attitude over this price factor which was not intended when the Dyestuffs Act was originally passed. The Dyestuffs Act was passed so as to give British makers of dyes the chance of building up their business against foreign, particularly German, competition, the idea being to prevent importation of dyes if the exact equivalent could be produced in this country. A very different aspect has been put upon it in recent years by the insistence on this price factor, which is very detrimental to British makers of dyes. British dye users are in a very good position to-day, as in the main we understand about 90 per cent. of required dyestuffs are made in this country, which, as far as quality is concerned, are fully satisfactory.

With regard to price, in many of the cases where large weights are concerned, prices of British-made dyes are well below twice the pre-war equivalent value. The main safeguard of the users against any undue price charges is that in the dye making trade no price ring or association is in operation, which is a very different position from that in the dyeing trade. It would be interesting to hear if the large price cuts which have been made in dyes due to internal competition between home makers have in their turn been handed on by the dye consumers to their own customers.

With regard to such colours as are being sold in this country still above twice the pre-war price, there is plenty of justification for such a price, *e.g.*, many of these involve the use of alcohol, which is very much more costly in this country than in Germany, and the use of which is also hampered by many difficulties and Government restrictions.

A further point that we are not satisfied with is that we have reason to believe that many of the German standards now being offered are all considerably increased in strength and tinctorial value against pre-war standards without any alterations of actual brand marks. This is causing a very unfair position to the makers on this side, as when pre-war price is taken into consideration only the price and brand mark are considered, without any consideration, as to increase in strength. The interests of dye makers in this respect are not being, in our opinion, fully safeguarded.

A Dyestuffs Research Director

The dyestuff makers have undoubtedly made very considerable progress during the last two years, and on the whole the 2½ times factor worked fairly satisfactorily, both to the colour makers and to the colour users, but in my view the reduction at one step from the 2½ times factor to the 2 times factor is an exceedingly drastic step to take. It really means a 20 per cent. drop in the gross revenue, and it will require a considerable increase in the weight of products sold to make up for this loss in gross revenue. It also appears as if the whole of the profits of the dyestuff makers would be absorbed in meeting this reduction in price, because, generally speaking, to diminish costs by 20 per cent. is more than can be achieved over the whole field of dyestuff making.

I am of the view that the reduction should have been more gradual, say a 10 per cent. cut now and another 10 per cent. cut at the end of 12 months, because the goal that is in view is to get the British dyestuff industry so firmly established that when the period of the operation of the Dyestuffs Act comes to an end in 1931, the industry will be in a position to withstand foreign competition. Until then, of course, British dyestuff makers have to concentrate their energies in perfecting their processes and methods of manufacture so as to get things on the best possible basis to meet world competition in 1931. In order to be able to do this, it is obvious that during the period of protection there must be a reasonable margin of prices in favour of the British producer, as compared with world prices, so that resources can be accumulated, thus enabling manufacturers to scrap obsolescent plant and install new processes, etc. In my view one of the most serious consequences of such a big drop as 20 per cent. in the price is that it will probably cripple the manufacturers' progress along these lines, and thus they will not be as ready to meet world competition in 1931.

The Geigy Colour Co., Ltd.

We appreciate your asking for an expression of opinion. As the matter has two distinct sides and our opinion naturally may be biased, we prefer not to express our views.

Clayton Aniline Co., Ltd.

We thank you for your favour of the 1st inst. regarding the reduction in the price factor recently decided upon by the Dyestuffs Licensing Committee, but prefer not to express any views upon this development.

The Rise and Development of the Vat Colours

By a Dyestuffs Chemist

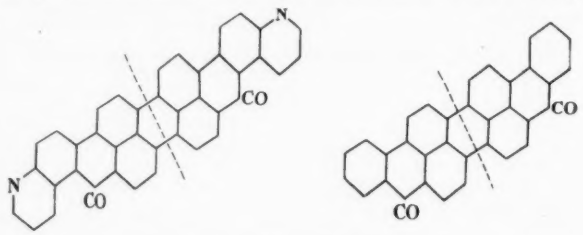
In the following article a well-known authority on dyestuffs production reviews the rise and development of the vat colours, the production of which constitutes, perhaps, the greatest triumph in this field since the attempt was definitely entered upon to establish a national dyestuffs industry for this country.

INDIGO is alone in historical importance and its record is unlikely to be challenged by another colour. Although the date when it was first used is unknown, and is unlikely to be known with certainty, this was not less than five thousand years ago. During this time it has been the world's principal dyestuff, and but for the very much later madder it has also been the fastest. With the introduction of the modern vat dyestuffs, however, its supremacy in fastness is now over. It is still the most important dye, judged by the quantity used, and should dyestuff development ever make it technically obsolete, its use would continue for many years afterwards.

The indigo colours now contain a large number of analogues of indigo itself, but with one or two exceptions these did not appear until after the anthraquinone vat colours, and then discovery was probably stimulated by the appearance of the anthraquinones, instead of vice versa, as might have been expected. The identification of madder as an anthraquinone derivative and the magnificent properties of Turkey Red led to the synthesis of the other alizarine mordant colours and later to the acid alizarine colours of the Saphirole type. The recognition of the excellent properties of these substances as regards permanence, was already by the end of the nineteenth century pointing the way to the extension of the anthraquinone derivatives in the direction of the vat type.

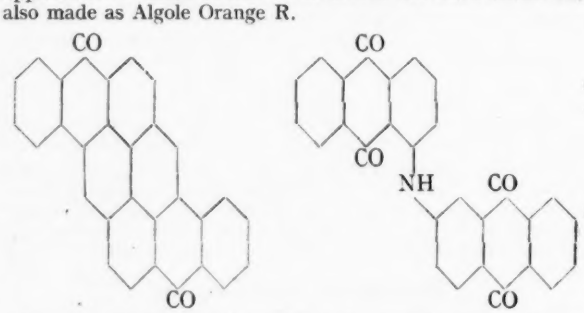
In 1901, Rene Bohn, a chemist in the employ of the Badische Anilin und Soda Fabrik, obtained a blue dyestuff by fusing β aminoanthraquinone with potash, which in physical and dyeing properties was similar to indigo. Its fastness properties proved to be remarkable and of a higher degree than any known previously. In fact, except in one important particular it has not been surpassed. It was placed in the market by the Badische Co., in the same year as Indanthrene X. Another derivative was soon prepared from the same intermediate, a bright yellow, which was called accordingly Flavanthrene.

During the next three years various derivatives of Indanthrene were described including the N.N. dimethyl compound, which was the first of the Algole colours of the Bayer Company, as well as the first cold dyeing vat. 1905 saw the dibenzanthrone colours. Bally found when the Skraup synthesis was applied to amino-anthraquinone in a similar manner to that used by Prudhomme nearly thirty years earlier in the production of Alizarine Blue, that in addition to the pyridine ring added through the nitrogen of the amino group, a benzene ring was also added, and this benzanthrone quinoline could be fused with potash to give a blue vat dyestuff Cyananthrene, later Indanthrene Dark Blue BT. Inspection of the formula of this will show it to be formed of two molecules of the benzanthrone quinoline joined across the dotted line. Further work showed that anthraquinone itself would give a benzanthrone, without the pyridine ring, and that this benzanthrone formed a similar double molecule which was also a dark blue. Violanthrene or Indanthrene Dark Blue BO. This colour is of special interest from the point of view of colour theory.



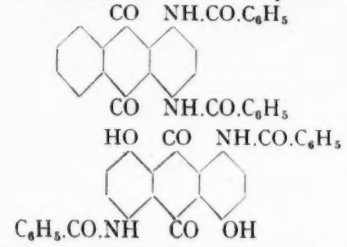
It contains only carbon. hydrogen, and oxygen, and was the first example of a deep colour containing only these three elements and free from nitrogen. Also it will be seen that in terms of the classical theory of O. N. Witt the molecule is one large chromogen containing two ketonic chromophores and free from auxochromes. Experience has shown that it is a superior colour to the Dark Blue BT, and this is no longer manufactured. Several substituted derivatives of Violanthrene and the corresponding Isoviolanthrene were soon also produced, including nitro-Violanthrene, a reddish blue product, which is reduced in the vat to the green amino-Violanthrene, Indanthrene Green B, and which on bleaching is converted to Black B.

Another complex nucleus was synthesised the next year. This was pyranthrone, with a general structure similar in appearance to violanthrone. The first of the anthrimides was also made as Algole Orange R.



In 1907 the first of the anthraquinone reds appeared, and was an anthrapyridone derivative.

1908 is important as marking the appearance of the benzoylamino anthraquinones, the discovery of which was second only in importance to that of Indanthrene itself. In a very comprehensive patent (Deinet and the Bayer Co.) a large number of vat dyestuffs of this type were described, many of which are still on the market. Two examples are given below.



These colours are to a certain extent of simpler structure than the ones which have already been mentioned, as the majority consist of a single substituted anthraquinone molecule, while in the preceding ones it is possible to see at least two such molecules embodied in each dyestuff unit.

They are in some ways more parallel with the acid anthraquinone colours, thus Algole Brilliant Violet 2B has a general resemblance to the Saphiroles.

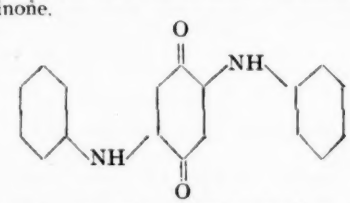
They have another distinguishing feature, in that they dye best at lower temperatures than the others, and are so called "cold dyeing" in distinction from the others, which are "hot dyeing." These benzoylamino anthraquinones were not, however, the first of the cold dyeing colours, the already mentioned dimethylindanthrene coming also in this class.

In this year also Meister, Lucius, und Brüning (Hoechst) entered the field with the Helindone colours, and the Society of Chemical Industry in Basle with the Cibanones. The first example of the former was Helindone Brown AN, which is probably a complicated anthraquinone derivative of the phthaloyl carbazole type. The Cibanone colours were sulphur colours obtained by fusing methyl derivatives of anthraquinone and benzanthrone with sulphur. They are, however, only sulphur colours by virtue of constitution and are not applied from a sodium sulphide vat, but from the more strongly reducing caustic soda-hydrosulphite bath.

Their constitution, like that of the majority of sulphur colours, is not accurately known.

The next two years saw the exploitation of the ideas embodied in the preceding developments and a large number of new colours were added to the list.

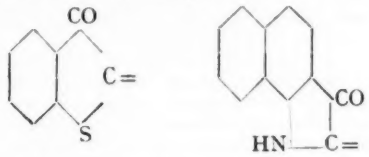
The first of the Hydron anthraquinone colours of Cassella, Hydron Yellow G, was discovered in 1911; this was not obtained directly from anthraquinone, but from carbazole, and contains two anthraquinone molecules. In 1911 also, Meister, Lucius, und Brüning brought out two Helindone colours of an entirely new type—Brown CM and Yellow GG—which were related neither to indigo nor to anthracene, but were obtained by the action of sodium sulphide on diarylido chlorquinones. The simplest of the diarylidochlorquinones is that obtained from two molecules of aniline and one of *p*. benzoquinone.



By the action of sodium sulphide further ring closing is assumed to take place. These were introduced for dyeing wool.

More or less side by side with the anthraquinone colours, the indigoid ones have been developed as well. In spite of the importance of indigo it is noticeable that although the synthetic product was being manufactured as far back as 1881, during the twenty years which came between this and the discovery of indanthrene, practically no essentially different indigo colours were put out. Friedlander discovered Thioindigo and Albrecht, Thioindigo Scarlet in 1905, and it was the two following years which were richest in results, while the succeeding ones have seen a constant and large addition to the patent literature of indigo and thioindigo bodies.

These belonging to closely similar types, are more easily classified than the anthraquinone bodies. Thus, either one or both halves of the indigo molecule can be replaced by groupings such as the following:



In addition to the colours already mentioned, there must be included the sulphur colours of the Hydron Blue type, which are quite distinct from the foregoing, being carbazole-indophenols. They are applied from hydrosulphite vats.

These developments bring the history of the vat colours to the years immediately preceding the war. The discoveries of 1912 and 1913 were not fully exploited before the war, and further progress was hindered during it. Two important dyestuff compounds were brought out, however, namely di-pyrazolanthrone and perylene tetra-carboxylic acid.

With the beginning of the war a new stage in the chapter of the vat colours opens. While in Germany progress was halted, the production of the already known colours went on as usual as far as it was necessary to satisfy market demands. In Great Britain, however, with the cutting off of further supplies an entirely different situation was created. On account of their unique fastness the vat colours had no substitutes, and while in the case of the other colours temporary makeshifts were possible, this was not so with the vats.

Manufacture was begun in this country as early as 1914 by Morton Sundour Fabrics, of Carlisle, who started production for their own internal use. Indanthrene Yellow G was produced in small bulk in 1914, and given the name of Caledon Yellow G. Indanthrene Blue followed soon after as Caledon Blue. As soon as production was large enough the colours were also put on the market and a gradually increasing range was brought out.

The colour manufacture department was then separated as a different company, first as Solway Dyes, and later, at Carlisle and Grangemouth, as Scottish Dyes.

Indanthrene Blue was also brought out by British Dyes, Ltd., in 1916, and in November, Levinstein's were manufacturing indigo at Ellesmere Port. Later L. B. Holliday and Co. and the British Alizarine Co. also started the vat colours, and the latest addition is Brotherton and Co., who are beginning with some of the dibenzanthrone series as Anthone Colours. Owing to America's later entry into the war the position there was different, and the first companies to take it up were the Newport Chemical Co., and the Du Pont de Nemours Co., with their Anthrene and Ponsol ranges. The vat colours of the anthraquinone series are now manufactured in Germany, Switzerland, Great Britain, and the United States, but France and Italy, who are also in process of developing national dyestuff industries, do not appear to have begun this class.

In Germany itself circumstances have altered considerably since the war, and the gradual tendency for joint working already evident before the war has developed through the Interessengemeinschaft to an actual union of companies in the Interessengemeinschaft Farbenindustrie Aktien-Gesellschaft. This has been accompanied by a recognition of the equivalence of the three great German series, the Indanthrene, Algole and Helindone, by the adoption of a single name, and by considerable post war propaganda for the exploitation of the fast dyestuffs. By the introduction of Indanthrene houses, where goods are sold under the guarantee of "Indanthrene dyed," with the corresponding fastness which this implies, the significance of Indanthrene has become a domestic one. "Indanthrene dyed" has, in fact, attained a wider significance than Indanthrene, for to fill certain gaps in the legitimate indanthrene series, colours considered to have the same standard of fastness have been brought in, including Alizarine, the Naphthol AS reds, Aniline Black, some of the Indigos and Thioindigos and Indocarbon.

In Great Britain the largest vat series is the Caledon, which now includes about forty members. Following the arrangement of last year, between the British Dyestuffs Corporation and Scottish Dyes, all the anthraquinone vat colours are now made at Grangemouth.

To within the last few years, progress in the making of new dyestuffs had been in abeyance. Manufacturers outside Germany have been fully occupied in duplicating known dyestuffs, and Germany herself has been hampered by internal conditions and the loss of markets.

However, in 1920, Scottish Dyes, Ltd., made a notable addition to the anthraquinone colours with Caledon Jade Green. A really satisfactory green had previously been lacking, and the new colour was remarkable for its combination of the highest fastness properties with unusual brilliance of shade. This substance is a dimethoxy dibenzanthrone.

At the present time research has got back to its old volume, and numerous patents are appearing each year, important amongst which are those dealing with benzanthrone compounds, to which greater attention has probably been given as a result of Jade Green.

The dibenzanthrone and isodibenzanthrone dyes have one point in common; they both include in their structure the five ringed hydrocarbon perylene.

This substance, unlike benzene, toluene, naphthalene, anthracene, carbazole, and acenaphthene does not occur in coal tar, but is synthesised in various ways from naphthalene derivatives. The simply substituted perylene derivatives are more deeply coloured than anthraquinone ones. They have met with a great deal of attention during the past few years, but how far they will find commercial application is at present uncertain.

The most recent development is of course the production of the Indigosol and Soledon Types of soluble vat colours, which need no further description at the present time.

The use of vat colours has increased enormously during the last few years, and is likely to go on doing so as their properties become more and more appreciated. Their production in this country has increased every year (with the exception of 1921) since manufacture was started. In the United States, where actual figures are available, the production of vat colours, excluding indigo, increased 43 per cent. between 1924 and 1926. Including indigo, the production was 31,730,178 lb. in 1926, as against 21,818,022 lb. in 1924.

Swiss Exports of Dyes

According to the official statistics for the past year, the export of aniline colours from Switzerland reached a figure of 59,365 quintals (quintal=2 cwt.), valued at 57,040,225 francs, as against 49,390 quintals in 1925, valued at 52,130,426 francs. The increase in quantity amounts to 21 per cent., whilst that of value is only 9·4 per cent. Imports of aniline dyes were 7,148 quintals, valued at 6,351,041 francs, as against 6,681 quintals, valued at 5,910,996 francs in 1925.

Shortly before the war Germany was the largest purchaser of Swiss aniline dyes, being responsible for between 21 and 23 per cent. of all exports. Next came the United States with 18 to 23 per cent., then Great Britain with 11 to 13 per cent., Italy 8 to 9 per cent., British India 7 to 9 per cent., and Japan 5 to 11 per cent. When war broke out, Germany disappeared altogether from the list, whilst the United States, Great Britain, Italy, and France took between 82 and 87 per cent. of Switzerland's aniline exports, Great Britain alone taking 40 to 50 per cent. In the year 1925, France took 21 per cent., the United States 16 per cent., and Great Britain 11 per cent. of Swiss dyes, whilst Germany only took 2 per cent. Last year, however, Germany again took the lead with 14 per cent. of all the exports, whereas France, Great Britain, and the United States all took about 12 per cent

New Italian Dyestuff Grouping

Four Companies Amalgamate

Reports are to hand of an amalgamation in the Italian dyestuffs industry. The new grouping covers for the time being three companies: the Sipe Cengio (Società Italiana Prodotti Esplodenti), the Fabbriche Italiane Materie Coloranti Bonelli, and the Italica (Società Italica Colori Artificiali). R. Panzarasa is the president and Professor Belloni the vice-president of the group. The Schiapparelli Company, which has specialised in its establishment at Settimo in the manufacture of pharmaceutical products, will also participate in the amalgamation. Thus the complete range which involves the manufacture of explosives, dyestuffs, and medicinal substances from tar will be covered.

In the Cengio plant of the Sipe, which was called into being by the "Italgas" (the latter possessing a large number of gas installations in Italy and distilling annually about 600,000 tons of coal), there are produced intermediate products for synthetic dyestuffs and medicaments. The daily production capacity of this plant amounts to 8,000 tons of aniline oil, 2,000 kg. of H acid and β-naphthol, 800 kg. paranitraniline and α-naphthylamine, etc. Apart from this there are produced numerous chloro- and nitro-derivatives of benzol, phenol, anisole, aniline, toluene and naphthalene, chromotrophic acid, β-hydroxynaphthionic acid, Naphthol A.S., etc. The production of explosives, which was the object of the Sipe, is continued on the large scale and permits of a considerable export. The plant for the production of oleum (with 25 to 70 per cent. free sulphur trioxide) has a capacity of 120 tons per day (calculated as monohydrate). In recent years there have been erected plant for the production of formic acid (2,000 kg. per day), the acid coming into commerce as 85 to 90 per cent.; an electrolytic mercury plant for caustic soda (4,000 kg.) and chlorine (3,500 kg.); and 100 per cent. sodium sulphide (4,000 kg.).

Dyestuff Production Capacity

At Cesarno Maderno there is extensive plant for the production of lead-chamber sulphuric acid; and synthetic hydrochloric acid, and nitric acid from sodium nitrate are also made, as well as caustic soda, chlorine, and sodium sulphide. The chlorine is used for the manufacture of solvent trichloroethylene, and of monochloroacetic acid, the latter being used mainly for synthetic indigo. The synthetic indigo plant is built on the most modern lines, and has a capacity of more than 1·5 million kg. annually. At Cesarno the production of sulphur blacks and other sulphur colours is highly developed. Many other important dyestuffs are also made, such as azo-dyes, direct colours for cotton, acid colours for wool, and an almost complete series of chrome colours for wool. The "Italica" company at Rho makes use mainly of intermediates from Cengio for the production of azo-, triphenylmethane-, and stilbene-dyestuffs, etc.

The total production of dyestuffs of the various plants now united amounts to 3·6 million kg. annually, including sulphur blacks but excluding indigo. There are 70 chemists, 200 members of the administrative staff, and 1,500 operatives. The main purpose of the new merger is the improvement of the organisation of the three undertakings, the abrogation of overlapping, completion of the range of products, and economic production, in order to permit of competition with the other great organisations in foreign markets.

Dyestuff Licences for May

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during May, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 656, of which 542 were from merchants or importers. To these should be added 29 cases outstanding on April 30, making a total for the month of 685. These were dealt with as follows:—Granted, 582 (of which 555 were dealt with within 7 days of receipt); referred to British makers of similar products, 77 (of which 58 were dealt with within 7 days of receipt); referred to reparation supplies available, 3 (all dealt with within 2 days of receipt); outstanding on May 31, 1927, 23. Of the total of 685 applications received, 616, or 90 per cent., were dealt with within 7 days of receipt.

Dyes and their Application: Recent Technical Progress

By L. J. Hooley

Theories of Dyeing

THE development of the technique of dyeing has been empirical rather than scientific. Even at the present time there is no generally accepted theory of the mechanism of the dyeing process, although considerable investigation has been carried out.

Investigations appear to have been carried out from entirely different angles. It might appear that different workers held entirely opposed and mutually exclusive views, and that it was still a case of deciding whether the process was a chemical one or was, say, merely physical. The solution of the problem, however, cannot any longer be considered as depending on a choice between mechanical, chemical, and solution theories, or even the later electrical, colloidal, and adsorption ones.

The best attitude towards the problem is probably to view the whole dyeing process from as general a standpoint as possible, and to keep in mind various factors which may be of importance. Amongst such factors there are the condition of the dyestuff in the bath, its degree of dispersion or ionisation; the properties and condition of the fibre itself and the possibilities of electric charges on its surface; the manner in which the dyestuff comes into contact with the fibre, and the succeeding stages of penetration, adsorption, solution, coagulation, precipitation of colloidal particles, or formation of compounds.

In individual cases, one or other of the above factors may assume sufficient importance to be virtually the cause of dyeing in that particular case, and to be specially favourable towards one or other of the theories. This viewpoint provides a frame of reference by means of which the significance of the various developments can be estimated.

Various aspects of dyeing theory are attracting considerable interest at the present time, and some very interesting papers have appeared recently.

On the question of giving one theory preference over another it will often be difficult to separate phenomena and label some chemical and others physical or electrical, and probably the electrical theory has the advantage of being the most general and most readily including the others.

Dyeing theory is receiving considerable attention at the present time, and as the dyer becomes more and more a chemist it will be likely to receive more.

Degree of Dispersion of Dyestuffs

The majority of dyestuffs do not, of course, form true solutions, but are in a condition between solution and colloid. Auerbach (*Textilber.*, 1927, 160) draws very interesting parallels between the degree of dispersion and other properties. He deals principally with the substantive, acid and basic colours, and the most interesting feature is perhaps the clearly marked differences which these classes show. Speaking generally, the three classes are present in the dyebath in different conditions, and their difference in dyeing properties may be more a result of the differences between their degrees of dispersion than between their chemical constitutions, although, of course, their chemical constitution may be the deciding factor in determining the degree of dispersion in solution. The author draws a series of graphs to illustrate the distribution of dyestuffs with regard to the various degrees of dispersion. First, taking the three classes together and plotting against the degree of dispersion the number of dyestuffs having this particular dispersion, it is seen that few dyestuffs are so finely divided as to be in a state of molecular dispersion and few properly colloidal, the great majority coming midway between. In the second diagram the author does the same thing, but considers the basic colours separately. The two curves for the basic colours and for the acid and direct colours combined, show that approximately the positive basic colours have a much higher dispersion than the negative acid and direct colours. Only a few basic colours are sufficiently aggregated to show particles as large as those of the direct colours, and it may be because they are too small that they will not dye cotton without a mordant. The substantive colours have a much lower degree of dispersion than the acid ones. In the fourth diagram the hot dye substantive colours are compared with the cold dyeing. The hot dyeing colours approach the colloidal condition, and at ordinary temperatures the particles would appear to be too large for absorption. The effect of a higher temperature is to cause disaggregation, giving a more suitable degree of dispersion for cotton dyeing.

Chemical Theory

It is in the case of the animal fibres where amino and carboxylic acid groups are known to be present that the argument for a chemical theory of dyeing is strongest, and if it is true that acid and basic colours dye wool by forming loose compounds with these amino and carboxylic acid groups, it should be possible to form compounds with simpler analogues of the amino acids present in wool and silk. Pfeiffer and Angern (*Z. angew. C.*, 1926, 253) have accordingly carried out experiments with phenylalanine and sarcosine. Phenylalanine and para-hydroxy-azobenzene were found to combine in equal proportions, as did also sarcosine and para-hydroxy-azobenzene. Sarcosine and 2 : 4-hydroxy-azobenzene combined in the proportions of 2-1. These products all had definite melting points and were readily dissociated in solution.

The view that dyeing wool with acid dyes consists of salt formation between the wool acting as base and the dye as acid is confirmed by K. H. Meyer and Fikentscher (*Textilber.*, 1926, 605). By observing the adsorption of Orange I and para-sulphobenzeneazoacetanilide in both coarse and fine wool fibres, it was found that the total absorption was independent of the surface area of the wool. It was also shown that wool will combine in constant proportions with different acids. Experiments with about 20 acids of different types showed that in each case the wool combined with the same number of equivalents of the acid.

Optically Active Dyes

Since wool and silk contain optically active compounds it is probable that if the dyestuff combines chemically with these, that enantiomorphic forms of the same dye would show different dyeing properties.

Brode and Adams (*J. Amer. C.S.*, 1926, 2193) have prepared optically active colours by coupling diazotised d-, l- and dl-phenyl (*p*-aminobenzoylamino) acetic acid with beta-naphthol and dimethyl aniline. They were, however, unable to detect any difference in the absorption of the two active forms in dyeing experiments, or in fastness to light or other physical properties. Racemic forms, however, appear to be taken up to a greater extent than d- or l-forms. In previous work on this subject, Porter and Ihrig had claimed to have observed differences, using other active components. Brode and Adams have therefore also repeated this work, but have been unable to confirm it.

Dyeing of Inorganic Substances

Evidence in favour of the adsorption and electrical theories of dyeing have been afforded by experiments carried out on the colouring of substances such as china clay and inorganic salts. The dyeing of these substances has been found to be very closely analogous in several ways to the dyeing of fibres. Of particular interest are the effects of impurities, and of the degree of hydration of the solid substance. It is shown, for instance, by Morley and Wood (*J.S.D.C.*, 1923, 100), that if titanic acid is prepared by separation from a solution which is slightly acid, it readily absorbs acid dyes and has little affinity for basic. Precipitation from alkaline solutions shows opposite results, and the product from neutral solutions shows little dyeing power with either.

In the case of precipitation from acid solution the excess of positive ions may be assumed to lead to deposition of some of these on the inorganic substance. When later this substance is placed in an acid dyebath the positive ions already present on the substance will attract the coloured negative ions of the dyestuff. Further recent work by Wood and Burns appears in *J.S.D.C.* 1926, page 187, where the behaviour of hydrated chromic oxide prepared under the different conditions is examined, and in the same Journal, page 211, where experiments are carried out on the absorption of Methylene Blue by zinc oxide.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

Business during the month was relatively good and showed a slight improvement over that of April. It is suggested in some quarters that the improvement will continue, but sound grounds for the belief are difficult to discover. The cotton trade still remains in an unsatisfactory state, and from the number of calls now being made on their unpaid share capital by cotton spinning concerns, it would appear that the Cotton Yarn Association's decision to raise yarn prices was dictated by sheer necessity. Whether this decision has had any real detrimental effect on the export market it is impossible to say, but there is no doubt that it will serve as the scapegoat until some other reason for the bad state of trade can be invented.

The decision to cut the two-and-a-half times price factor to two has been made by the Dyestuffs Advisory Licensing Committee, and will come into effect in September. The decision would appear to be a sound one on general grounds, but, nevertheless, the cut of 20 per cent. which is involved in the price of some dyestuffs cannot but present serious difficulties, if not actual loss, to dyestuff manufacturers. It should not be impossible to devise means whereby such special cases could be taken care of in any future cuts, and the task would appear to fall to the manufacturers. In fairness to the general consumer, it should be stated that he has never taken undue advantage of previous cuts in cases where he felt that the manufacturer was placed in an impossible position.

Mr. A. Hoegger, the chairman of the British Cotton and Wool Dyers' Association, who, in common with many chairmen, incorporates opinions on businesses other than his own in his annual addresses to his shareholders, can usually be relied upon to provide a few home truths for British dyestuff manufacturers; but this year's remarks are so mild as to excite suspicion. Is he really satisfied with the progress made or is he getting mellower? Whatever the reason, those connected with dyestuff manufacturing concerns must feel that the change is a step in the right direction and one consonant with increasing confidence in their ability to take care of themselves.

Yorkshire

Last month we referred to depression of mind consequent upon the deviation shown by April's trading from the trend of improvement to which we had grown accustomed from the beginning of the year. It is pleasing to report that our hope at the same time expressed has been realised and that May has restored the *status quo*.

Fancy weaves and rich colourings continue to hold sway in the Huddersfield worsted trade, which is enjoying a healthier life. The woollen trade, too, is fairly busy and more labour is being absorbed. According to the records of the local employment exchange, no weavers were unemployed at the end of the month, although short-time was widespread. There is a substantial amount of work for winter delivery and for export even to the Continent; a run on flannels for the home trade is being experienced. It is pleasing to record with regard to the heavy woollen district that the uncertainty of the better conditions existing immediately prior to the Easter holidays continuing has now been removed by the experience since of a healthy tone. Although it is confidently felt that a real recovery is taking place, conditions are still far from normal. Improvement here is observed in shipments to the Continent, and Canada and U.S.A. also are at present good customers. No real improvement in the Far Eastern market is expected while the trouble in China continues. Demand for bright colours in women's wear continues to predominate. Dyeing in Halifax in all sections is reported to be quiet. Brysilka, Ltd., artificial silk manufacturers, Bradford, began work about the middle of the month on extensions which when completed in five or six months will employ an additional 600 people. The firm, it is understood, intend also building new premises at Guiseley.

Much has been written and spoken of prices of dyestuffs and the Dyestuffs Licensing Committee price factor, and the makers have proved to be interested readers and listeners. It is true that there has been some cutting, more particularly in sulphur blacks and acid colours, but on the other hand it is known that there are acid and basic colours which have recently been advanced in price. The dyer appears to regard the cutting of dyestuff prices with mixed feelings, for it most assuredly leads to the cutting of his dyeing prices should he stand alone and not be combined in a powerful association. The maker feels that cuts in his prices, which he can ill afford, go largely to swell still more the already swollen dividends of those associations and are very rarely passed on to the consumer.

Solvent naphtha demand is flat; the price has dropped from 1s. 6d. earlier in the year to about 10½d. per gallon to-day. Some very cheap parcels of concentrated sodium sulphide are to be found floating about the market and questions are asked as to whether it is jetsam from Arcos, Ltd.

Scotland

May has been a fairly uneventful month in Scotland. Speaking generally, trade is managing to keep up fairly to the slightly better level reported last month. There is not anything in the nature of a boom taking place, but most of the dyeing and printing works are able to work longer hours than in previous months. In the Vale of Leven and the Glasgow and Paisley districts, the majority of the workers are on full time. The Scottish tweed trade remains good and the shortage of skilled workers continues; new hands are reported to have been taken on from Yorkshire and from Ireland. In the hosiery section, knitted wool goods, particularly of the fancy type, are the most in demand, the section otherwise being rather dull.

The British Cotton and Wool Dyers' Association, Ltd., nearly half of whose branches are in Scotland, were only able to report a net profit about half that of the previous year. Half of the drop was accounted for by increase in fuel charges. The latter half of the year's report was much better than the former. It is now twenty-seven years since the formation of this body, and at a time when amalgamation and pooling of interests and information is becoming increasingly important, the British Cotton and Wool Dyers' Association are entitled to look back and congratulate themselves on their foresight in doing this as early as 1900.

The reports of most of the textile, dyeing, and finishing companies for the periods covering the general strike are now known, and the results can be regarded with some satisfaction.

The substitution of the new "twice times" factor for the old "two-and-a-half" factor, starting from next September, is welcomed by the consuming trade, and its successful operation will mark the most tangible success of the dyestuff makers to date. It is hardly to be expected that the dyestuff makers will find the change welcome. In a field where there is so little margin for cost reduction by increased output, price reductions are particularly difficult to make good. In fact, the enormous drop in prices during the last six or seven years, is probably the strongest evidence of the virility of the industry.

Removing Nigrosine Stains from Hosiery

NIGROSINE is used for making black shoe polish, hair dyes, and various types of ink. As a result, light-coloured hosiery is frequently spotted with Nigrosine. In the past much difficulty has been encountered in removing stains of Nigrosine from hosiery and other garments and fabrics. Recently, Mr. M. H. Goldman, Research Associate of the National Association of Dyers and Cleaners, working in the laboratories of the Bureau of Standards, has found that the organic chemical benzaldehyde, if properly used, is quite effective in the removal of stains which are fundamentally due to the presence of Nigrosine. The method of procedure is as follows:—

Spot the stain with benzaldehyde, following this treatment with 5 per cent. ammonia, meanwhile gently rubbing the spot. A single treatment is sometimes all that is required, but a second and in some cases a third application of the benzaldehyde followed by ammonia may be necessary before the spot is completely removed. The spot to which the treatment is applied is finally sponged with dilute alcohol to remove any excess of benzaldehyde that may be present, and also to avoid leaving a ring on the fabric.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

The Hardness of Different Structures in Steel

A Recent Japanese Investigation

There has recently appeared, as No. 67 (volume 5, pp. 25-44) of the Scientific Papers of the Institute of Physical and Chemical Research of Tokyo, an account of an investigation "On the Hardness of Different Structures in Steels," by K. Tamaru. We give below a reproduction of the more important points raised in the paper.

In 1906 and 1908, Boynton (*Iron and Steel Inst.*, 1906, ii., 287; 1908, ii., 113) reported a systematic investigation of the hardness of the constituents of steel, using Jaggar's instrument, in which the diamond point rotates on the surface of specimens. He gave the following relative hardness numbers:—

	Average Hardness.	Ratio.
Ferrite	460	1
Pearlite	2,000	4·3
Sorbite	2,400–24,000	5·2–52·0
Troosite	40,500	88·0
Austenite.....	48,000	104·3
Martensite ...	110,000	239·1
Cementite	125,000	271·7

In his method the resistance offered to abrasion caused by a uniformly rotating diamond point is used for measuring the hardness. This principle of the hardness measurement is quite different from those applied at the present day. The method of test used by the present writer in the investigation of the hardness was the indentation one.

It is well known that in the case of carbon steel, a specimen consisting of austenite alone cannot be obtained by quenching, but that such a structure can easily be obtained by adding a certain amount of manganese. The relative composition of carbon and manganese for obtaining the austenitic structure by quenching the steel in water as determined by the present writer, indicates that when the carbon content is only a trace, austenite is obtained containing more than 16 per cent. of manganese. With increase of carbon content, the quantity of manganese required decreases; and with 2·0 per cent. of carbon 5 per cent. of manganese is sufficient to produce an austenite structure. The austenite is paramagnetic, but the other structures are all magnetic; hence the purity of the austenite can be detected by a magnetometer.

Carbon Steel

The hardness of austenite at room temperature was determined in specimens 8 mm. in diameter and 3 cm. long, made from a forged steel containing 1·69 per cent. of carbon. They were heated at 1120 to 1130° C. for 30 minutes and then quenched in calcium chloride solution at −15° C., calcium chloride solution at room temperature, and water at room temperature. It is known that a calcium chloride solution is one of the best quenching media, and hence quenching solutions of different temperatures were used so as to obtain specimens containing different amounts of austenite and martensite. On etching the specimen with picric acid, white martensite needles are revealed in a ground mass of brown austenite. A microphotograph of each specimen was taken, and after measuring the area of the martensite by a planimeter, the percentage of this area was calculated. Further, the hardness of each specimen was measured by a Rockwell hardness tester at three to five different points. Table I illustrates the relation between the hardness and the martensite area.

TABLE I

Specimen No.	Rockwell Hardness.	Martensite Area per cent.	Remarks.
1	44·2	49·8	
2	46·5	53·7	
3	51·5	66·8	
4	54·0	69·8	
5	53·5	63·1	
5′	62·0	80·0	Immersed in liquid air.
6	38·3	35·1	
7	35·8	29·7	
8	30·1	24·6	
9	14·2	6·0	
10	40·5	41·5	
11	39·0	34·2	
12	44·1	46·2	
13	61·0	75·0	Immersed in liquid air.

Effect of Cooling

As the specimen contained more austenite than martensite, the change from the former to the latter structure takes place for the most part below room temperature. Thus the hardness of specimen No. 5′ after being immersed in liquid air for 30 minutes is increased from 53·5 to 62·0 owing to the transformation of the retained austenite to martensite. Specimen No. 13 is also cooled once in liquid air; here, as the martensite structure is very fine, the planimeter measurement was not possible, and hence recourse must be had to the X-ray analysis. A graph indicates that the hardness of austenite taken on the Rockwell "c" scale is 9 (155 in the Brinell scale) and that of martensite is 6·85 (720 in the Brinell number).

As regards austenite at high temperatures, the hardness above the A_3 point was measured by using Honda-Sato's impast hardness tester (Sato, *Kinzoku no Kenkyu*, 1924, 714). A specimen of an annealed steel measuring 29 mm. in diameter and 15 mm. in thickness was kept for 20 minutes at different temperatures, and then the hammer of the tester was let fall and the height of the rebound was reduced to the Shore scale. Table II shows the result of testing a 0·6 per cent. carbon steel and Table III that of a 0·8 per cent. carbon steel. Both have a small minimum between 400° and 500° C. and a maximum at about 600° C.; the hardness number above 800° C. falls to 10.

TABLE II (0·6 PER CENT. C)

Temp. °C.	Hardness.	Temp. °C.	Hardness.
15	23	702	20·5
137	22	711	19
228	21·5	725	18
330	21	776	16·5
434	20	826	10·5
534	21	856	10·5
630	21·5		

TABLE III (0·8 PER CENT. C)

Temp. °O.	Hardness.	Temp. °C.	Hardness.
14	23	668	20
125	22	710	19
222	21	722	17
340	20·5	766	15·5
475	19·5	816	10·0
573	20·5	866	10·0

As regards the hardness of austenite in manganese steel at room temperature, Hadfield and Hopkinson (*Iron and Steel Inst.*, 1914, i, 106) obtained a Brinell number 200 for the hardness of the austenite in a manganese steel containing 1·2 to 1·3 per cent. of carbon and 12 to 12·6 per cent. of manganese, quenched from 1050° C. In the writer's experiment, specimens having various manganese contents together with a constant carbon content, which lie all in austenitic region, were prepared: their compositions were :—0·8 per cent. C, with 10, 14, 18 and 22 per cent. Mn, and 1·2 per cent. C, with 7, 10, 14, 18 and 22 per cent. Mn. The hardness of austenite of manganese steel is nearly 185 for all manganese content, and does not seem to be greatly affected by a carbon content.

Manganese Steel at High Temperatures

In order to determine the hardness of austenite in manganese steel at high temperatures, manganese steels which had the following percentage compositions were quenched in water from 1050° C. and made austenitic :—C, 0·93 ; Mn, 9·63 ; S, 0·01 ; P, 0·06 and Si, 0·26. Its impact hardness at different high temperatures was measured by Honda-Sato's tester. Table IV shows the results of the measurement. With a rising temperature the hardness of the austenitic manganese steel first decreases and after passing through a minimum at 300°, begins to increase ; it reaches a maximum at 600° and then again decreases. The hardness numbers as measured during cooling have the same values as in the heating. The hardness-temperature curve of austenitic nickel steel (0·42 per cent. C, 26·73 per cent. Xi), measured by the same tester, shows a maximum at 630° C. The maximum probably corresponds to the blue shortness in steel ; in the statical test, the same maximum occurs at 200° to 300° C. The position of the maximum is displaced to a higher temperature as the velocity of loading increases.

TABLE IV

Temp. °C.	Hardness.	Temp. °C.	Hardness.
15	32·0	614	28·0
122	26·0	713	24·0
220	24·0	781	19·5
318	24·0	848	16·5
407	24·5	894	15·0
515	27·5		

The presence of the maximum at 600° C. was at first attributed to the change of the austenite into martensite ; but as it is confirmed that during cooling from 600° C., the hardness takes the same values as in heating, the above view is not correct, that is, the martensite is not yet sensibly formed. Hadfield and Hopkinson reported that on heating a water-toughened manganese steel at 500° to 600° C. it became hard and magnetic, the structures changing to the needle-like form similar to that of a martensitic steel. Arnold and Read (*Iron and Steel Inst.*, 1910, i, 169) reported on the chemical and microscopical analysis of the annealed manganese steel ; in their paper they explain the effect of annealing in causing the hardness and the magnetism as due to some change in the relation of carbides to iron. McKee (*T.A.I.N.E.*, 53, 1915, 437) reported that heating a water toughened manganese steel at 390° C. and cooling in air cause a heavy separation of cementite. From these investigations, it is evident that the separation of carbides takes place during annealing ; but according to the view of the present writer, as the heating time is comparatively short, the main cause of hardening at high temperature is due to the blue shortness, which is not in any way related to the structure. The measurement of the electric resistance of the manganese steel during heating and cooling shows that during heating the resistance increases with the rise of temperature, and at 210° C. its rate of increase becomes slightly less, indicating the separation of cementite ; above 500° C. it considerably decreases, showing the separation of carbides as well as the removal of internal stress. During cooling, the resistance steadily decreases with the fall of temperature so that it is always less than the corresponding values during heating. Heating the water-toughened manganese steel at 250° C. for 3·5 hours causes no change in its microstructure to appear, but heating it at 450° C. for 30 minutes results in a considerable separation of carbides. Lastly, comparing the hardness of austenite in manganese and carbon steels it is found that at 280° C., at which the transformation from pearlite to austenite has been proved to be completed, the hardness of carbon steel is 10 and that of manganese steel is 17 in the Shore scale, the difference being 7, or 42 in the Brinell scale. If this difference in the hardnesses at high temperature persists at room temperature, the hardness of austenite in carbon steel, 155, increased by 42, that is 197, will be that of austenite in manganese steel. This number is in good agreement with the value 182 actually observed. Hence the hardness number 155 in the Brinell scale is the probable value of the hardness of austenite in carbon steel at room temperature.

As already discussed in the foregoing paragraph, the hardness of martensite in a 1·69 per cent. carbon steel quenched from 1120–1130° C. is 68·5 in the Rockwell " c " scale or 720 in the Brinell scale. The relation between the hardness of martensite and the length of martensite needles was also investigated, the result being shown in Table V. From this we see that the

TABLE V

Specimen No.	Rockwell Hardness.	Length of Martens. Needles 1 by 10^2 mm.	Number of Needles measured.
2	46·5	1·19	474
5	53·5	0·91	426
6	38·3	1·81	184
7	35·8	2·43	103
8	30·1	2·26	92
10	40·5	1·90	221
11	39·0	1·70	197
12	44·1	1·79	199

hardness of the martensite increases as the length of the martensite needles diminishes, a hardness number even as large as 67·5 being obtained for exceedingly minute needles. Though this result is an approximate one, the maximum hardness corresponding to very small martensite needles is 67·5. In order to study the relation between the hardness and carbon content in steels, specimens (25 by 25 by 32 mm.) of Swedish carbon steels containing from 0·1 to 1·5 per cent. were heated at temperatures shown in Table VI for 30 minutes and then quenched in water. The hardness in the centre and the outer portion of the specimens was measured. Table VI shows the results of measurements. Up to 0·8 per cent. of

TABLE VI

Specimen No.	C per cent.	Quenching Temp. °C.	Brinell Hardness (Average of two) Centre.	Edge.	after immers. in liq. air.
37	0·10	900	160	168	—
38	0·20	880	277	298	—
39	0·29	850	383	405	—
40	0·40	820	477	502	—
41	0·50	810	524	568	—
42	0·59	805	588	622	632
43	0·71	802	622	642	683
44	0·81	800	665	637	—
45	0·89	800	658	627	—
46	1·02	800	642	622	684
47	1·10	815	642	622	689
48	1·19	855	617	588	—
49	1·28	895	573	560	658
50	1·48	980	528	484	—

carbon content the hardness increases with the carbon content, and afterwards gradually decreases. Below 0·7 per cent. of carbon the outer portion is harder than the central ; because, owing to its low carbon content, martensite is well developed in the outer portion in the specimen, while a small quantity of troostite is found mixed in the centre. Above 0·8 per cent. of carbon, the outer portion is softer than the inner ; because, in virtue of high carbon content, more austenite is formed in the outer position than in its centre. At any rate, the maximum hardness in the two portions was in both cases 650 in the Brinell scale. The fact that above an 0·8 per cent. of carbon content the hardness decreases, is probably due to the increase of retained austenite as well as to the growth of the martensite crystals.

TABLE VII

C per cent.	0·71	1·19	1·48
Quench. Temp. °C.	802	855	980
Aust. amt. at per cent.	10	15	20

Table VII is the result of the X-ray analysis for the quenched steels, and shows the increase of austenite present in martensite with increasing carbon content. If the quenched specimen is immersed once in liquid air, the hardness increases to 690 and is almost independent of the carbon content. But even

with this cooling, a part of the retained γ-iron still remains untransformed, and therefore the specimen is not so hard as pure martensite (720 in the Brinell number.) In the case of a specimen containing 1·69 per cent. carbon, which was quenched from 1130° C. in a calcium chloride solution and afterwards immersed in liquid air, about 10 per cent. of the γ-iron was detected by X-ray analysis. A hardness measurement of a quenched steel by Wahlberg (*Ir. St. Inst.*, 1901, i, 267) showed a maximum hardness 652 at 0·65 per cent. of carbon.

Specimens (25×25×32 mm) containing 0·89 per cent. carbon were heated at 850° C. for 30 minutes, quenched in water and then tempered at various temperatures for one hour. After cooling slowly the hardness was measured. The hardness of tempered specimens at 112° C. is greater than that of the quenched one, the Brinell number being 683 against 660. As the tempering temperature further rises, the hardness gradually diminishes, with exception of three abnormal changes which take place at 150 to 200, 350 to 400 and at 430 to 450° C., the former two corresponding to the tempering of the so-called A and B martensite and the last the recrystallisation of the steel. Grard (*Rev. de Me.*, 1911, 241) also found the increase of hardness at about 100° C. but he failed to observe these three abnormal changes just referred to. Above 450° C., the internal stress is removed and the grain size grows gradually as the result of tempering, so that the hardness decreases. The hardness of troostite in 0·89 per cent. carbon steel is about 400, and that of sorbite 270 in the Brinell number. Next we shall consider the cause of the temper hardening above 100° C. Enlund (*Ir. St. Inst.*, 1925, 305), investigated the effect of annealing upon quenched carbon steels by means of the electric resistance, heat evolution, specific volume and microscopic examination, and confirmed the fact that the martensite is transformed into troostite at 100 to 200° C., the reaction being most marked at about 110° C., and that the retained austenite is decomposed at about 260° C.

Austenite, Martensite, and Troostite

If the martensite decomposes into troostite at 110° C. as Enlund said, the hardness must decrease at that temperature. As a matter of fact, the steel becomes harder at that temperature. Hence the present writer further investigated the phenomena in the following manner. A quenched steel containing 1·69 per cent. carbon was tempered at various temperatures for 30 minutes, and one and the same point on the specimen was in each case examined under a microscope. In specimens tempered at 100° C., no change was observed; in those tempered at 128° C., the martensite formed by quenching began to be transformed into troostite and turned a brown colour. At the same time, a part of austenite was transformed into martensite of the characteristic white needles, but on a further heating at the same temperature, the needles also became brown. At 240° C. the whole of the austenite was transformed into martensite and at 270° C. the martensite was transformed into troostite. From these results, we may conclude that the increase in hardness at 110° C. was mainly due to the transformation of the retained austenite into martensite and that the transformation of martensite into troostite affects its hardness but slightly.

The above changes during tempering were also studied by means of the differential dilatometer constantly used in our Institute; quenched steels containing 0·89 and 1·69 per cent. of carbon were studied, annealed steels of the same carbon content being used as the neutral. The results show that at 110° C. these specimens do not show the expansion which should be caused by the transformation of the retained austenite into martensite, but a gradual contraction; because at 110°, only a small amount of the austenite changes into martensite and at the same time a considerable amount of the martensite changes into troostite, this change causing a contraction. The transformation of the retained austenite into martensite in the vicinity of 240° C. accompanies an expansion and that of the martensite into troostite at about 270° C., a contraction.

The hardness of cementite can not be measured directly because of its extreme brittleness. Its hardness, as measured by the Mohr scale, is not certain, the value varying even by 100 per cent. It is known that in the case of the binary alloys, consisting of a mechanical mixture, the hardness is approximately a linear function of a component, provided these constituents remain constant in size. Applying this principle to the case of spheroidal cementite, Portevin (*Ir. St. Inst.*, 1921, ii, 61) obtained 400 in the Brinell scale as the hardness of cementite. The present writer determined the hardness of cementite in the following manner. Steels containing more than 1·0 per cent. of carbon were cast in a thick copper mould with a thin rectangular hole, and a plate of 1·5 mm. in thickness was obtained, which showed no trace of the decomposition of cementite. The hardness of the plate was then tested by a Rockwell hardness tester; the results are shown in Table VIII. Since the plate was very thin, it was also tested longitudinally, which showed the same hardness number. Thus the hardness of cementite was found to be 74 (820 in Brinell scale).

TABLE VIII

Specimen No.	C per cent.	Rockwell Hardness (aver. of 4)	Hardness after annealing.
65	1·02	46	—
66	1·19	49·5	—
67	1·48	47·5	—
68	1·92	53·5	37·0
69	2·92	58·6	45·0
70	3·70	61·1	50·0
71	4·28	66·5	—
72	4·90	66·0	—
73	5·55	69·0	58·0

Since the specimens here employed were obtained by a quick cooling in the copper mould from the melt, they may be subject to an intense internal stress, and consequently their natural hardness may be greatly increased. The same remark equally applies to the case of the austenite and martensite obtained by quenching. To estimate the effect of the internal stress on the neutral hardness of cementite, these specimens were heated at 650° C. for 10 minutes, and then their hardness measured; in this case no trace of graphite was observed. According to recent investigation in our Institute, in the case of steel, this heating is sufficient to remove the internal stress. 64 in the Rockwell scale (640 in the Brinell scale) was obtained as the natural hardness of cementite.

The results of the hardness measurement for different structures of carbon steel and its important constituents so far obtained are tabulated in Table IX. Boynton ascribes to austenite hardness of too high a value, placing it between troostite and martensite.

TABLE IX

	Brinell hardness number.	Remark.
Armco iron, normalised	90	* subjected to internal stress
austenite	155 *	
normalised steel (0·9% C.)	225	
sorbite (0·9% C.)	270	
troostite (0·9% C.)	400	
martensite	720 *	
cementite	820 *	

Summary

The result of the present investigation may be summarised in the following words :—

1. The relative composition of carbon and manganese which is just sufficient to obtain austenite by water quenching, has been determined.

2. The hardness of both austenite and martensite in carbon steel at room temperature has been found to be 155 and 720 respectively in the Brinell scale.

3. The hardness of austenite in carbon steel has been found to be 10 in the Shore scale at 820° C.

4. The hardness of strained cementite has been found to be 820 and its natural hardness 640 in the Brinell scale.

5. The hardness of austenite in manganese steel both at ordinary and at high temperature has been found to be 182 in the Brinell scale and 17 in the Shore scale respectively.

6. The variation of hardness in carbon, nickel, and manganese steels with temperature has been measured.

7. The relation of the hardness of quenched steel with regard to the carbon concentration has been determined.

8. The relation between the hardness of a quenched carbon steel and the tempering temperature has been determined.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Corrosion and Electrolysis

It may be doubted if the practical jettisoning of the molecule in that branch of chemistry that was once called molecular physics has been all gain to the cause of correct physical conceptions. The chemist and the physicist have an old quarrel on this account, and the atom of the one by no means always behaves as the atom of the other does under the stimulus of scientific imagination. The whole theory of electro-plating is certainly explained by theories in which the molecule plays little part, even as a phantasmagoric radicle; partly de-electronised particles or ions serve very well to explain the hypotheses. It is more than probable that the whole vexed question of corrosion will eventually be solved by properly co-ordinating the observed facts of electrolysis in the plating bath. There are at least three theories of corrosion extant, despite the fact that what is termed corrosion in respect of one metal—iron is the favoured type—may and probably does differ entirely from what is understood by corrosion in respect of another metal. The function of an electrolyte is obviously that of a solvent, and its potency in that respect is a function of many variables, of which the nature of the metal exposed to its action is, again obviously, one of the most important. There is rather a tendency in modern physics to become metaphysical in its endeavour to probe ultimate causes. The exercise of a right degree of scientific imagination is one thing, speculative mysticism is another, and perhaps less harmless and even less useful pursuit. Dr. Carl Benedicks trenches, in his latest volume of collected metallographic researches, rather dangerously, on the realms of pure speculation.

Metaphysical Chemistry

The trouble is not so much in the exercise of the imagination as the tendency to postulate that the things imagined are the things that are, and for the chemico-metaphysician to become didactic accordingly. Dr. Benedicks has some ingenious views on the kinetic constitution of solid matter, in pursuit of which he flogs a good many dead horses with skill and agility. He is dead against "repulsive forces" in solid bodies, although he admits the existence of "a repulsive force coming into action when the distance between the centres of two atoms is very short—otherwise the atoms would not preserve their individuality." When a body cools enough he believes "agglomeration" takes place. The thermal agitation becomes so weak that the close-packed atoms of what he terms the dynamic lattice can no longer rebound, but stick together. The outer electronic orbits come into persistent contact. Apparently they become immobilised as well—the electrons, not the orbits. It was Humpty Dumpty who remarked so profoundly the words *fiddle-de-de*, and ended up by saying "*impenetrability, that's what I call it.*" But Professor Benedicks's hypothesis does away with impenetrability altogether. The atoms stick together and there is no more to be said!

The Non-Ferrous Trades

The year that has just closed has borne perhaps with greater hardship on the heavy iron and steel trades of this country than on any other industry. The non-ferrous metal trades have suffered to nothing like the same extent. A possible, but not altogether probable explanation might be sought in the fact that the production and working of these metals do not involve the consumption of fuel to anything like the same degree as the ferrous trades. Pig iron requires fuel in a dual capacity: to supply heat, and for the sake of the actual carbon required in the reduction of the iron oxides and carbonates employed. The open hearth furnace and both the steel and iron foundries are extravagant users of coal. Of the few non-ferrous metals actually produced in this country either from the meagre home supplies of tin or lead ores, it may be said generally that less coal is required; in lead ores, for example, the sulphur often serves to some extent the function of a fuel. The bulk of the non-ferrous metals worked in Great Britain are imported and only need refining—as in the case of antimony—or rolling, forging, drawing, extruding, or a foundry operation which, however, extravagant so far as fuel consumption is concerned, is less so than the parallel operations of an iron or steel works. Such a view would, perhaps, be superficial. The facts recited may be a contributory cause of the relative prosperity of the non-ferrous industries, but it is not the only cause.

New Metallurgical Requirements

If it were so, the steel-rerollers, whose fuel consumption is relatively small, would have been similarly prosperous. This has not been the case. The causes are deeper, and it is well that metallurgists and industrialists alike should give consideration to these causes and the mode in which they are at present operating, for they cannot fail in the long run to have a profound effect upon the state of industry throughout the country. The needs of modern engineering are not the same as those of engineering in the past. High pressure steam turbine practice, automobile engineering, and the development of aeronautics have created demands for metals the qualities of which must transcend in many respects those sought in the past. Corrosion takes its annual deadly toll of iron and steel. A metal that lasts twice or three times as long may be an economic metal, even if it costs nearly twice as much. The tendency is to use ferrous alloys with more and more of other metals and less and less of iron in their composition. There is likewise a growing tendency to use alloys of nickel and chromium as strong, and, in severe service, stronger and far less prone to corrosion than plain iron and steel.

The Potentialities of Metallic Alloys

The copper-nickel alloys, the brasses, and the bronzes, are coming in for increased attention: new ranges of quality are available as the result of modern scientific research. The number of binary alloys possible within the range of the ordinary industrial non-ferrous metals of commerce has been computed at 435; the number of ternary systems at 4,060. Yet most of the new alloys such as stellite, alpax, lautal, duralumin, etc., are at least ternary or quaternary alloys, the permutations and combinations of which approach infinity. Of these a large number have very special uses and applications. Finally, we have to reckon with new metals: aluminium, for one, magnesium for another, chromium for a third, and cadmium for a fourth. Already the beryllium-copper and magnesium-beryllium alloys are attracting attention. Iron and steel have formidable rivals to contend with, and, in this country at least, appear to be losing ground.

Economies of Magnesium

The term new, as used above, is a relative one. Aluminium is really a new metal for engineering construction. Magnesium in such connections is even newer. The annual production of aluminium is in the vicinity of 200,000 tons. That of magnesium can only be guessed at; some countries, for military reasons, refuse to allow output statistics to be published. It may be estimated at round about 5,000 tons. It is certainly increasing. Its metallurgy is attracting an enormous amount of attention in Germany, France, Italy, and America, in all of which countries the metal is being actually produced. Little, if any, is actually produced in this country. It is sincerely to be hoped that the potentialities of this metal will not be neglected by British manufacturers. That its price, 4s. a pound, is against its extended use is a pure fallacy. It has just been exposed in the *Revue de Métallurgie* by R. De Fleury, who shows that even were it many times higher, it would still subserve serious economic needs, apart from its invaluable possibilities in time of war.

Carrying Capacity as a Criterion

Monsieur De Fleury gives formulae showing the maximum price at which an ultra-light metal such as magnesium could be sold without sacrificing any economic advantage involved in the use of a heavier but cheaper metal. Construed in terms of carrying capacity—and hence earning capacity—magnesium at 300 francs per kilogramme, or, say, 12s. 6d. to 15s. per pound, would still be an economic proposition. The argument is one which, *mutatis mutandis*, could be extended to other forms of transport engineering: motor lorries, locomotives, and steam ships, and indeed, to many other

applications as well. He proceeds, moreover, to give much valuable information as to the metallurgy of refining, casting, rolling, and forging magnesium—information of a kind that has not hitherto been forthcoming. The article is one of extreme importance to practical metallurgists, and divests an important subject of much of the mystery which has hitherto surrounded it. The main contention that when value in service is taken into account, magnesium is an economic proposition, is a point of view which needs emphasis, and should be borne in mind by engineers.

Abnormal Gas Absorption of Steel

At a Faraday Society meeting held a short time ago, a paper on "Absorption of Gases by Steel" was read by Messrs. T. Carlton Sutton and H. R. Ambler, of the Research Department, Woolwich Arsenal. The research described originated in some work on the calorimetry of high explosives. The explosives were confined in ¼-in. steel containers, suspended in a large closed vessel. When the mass of the products of explosion (gaseous and solid) was examined, it was found that the total amount of each of the elements in the explosive did not reappear in the measured products of the explosion. If these discrepancies were to be accounted for on the hypothesis of occlusion of some of the gaseous products in the steel dust, which is formed when the container fragments, the absorptivity of the steel-dust would have to be more than ten times greater than the highest value hitherto recorded. Experiments were therefore put in hand to determine whether under the extreme conditions to which the steel was subjected this could possibly be the case. From the results obtained, there now appears to be no doubt that the absorptivity is actually many times greater than was supposed.

Nature of the Absorption

Attention was directed, in this investigation, to the amount of gas absorbed by the steel rather than to its composition, and an intricate detailed investigation would be needed to determine in full the various actions that may perhaps participate in these absorptions. Some of the absorption may, perhaps, be due to the formation of a compound; in fact, it seemed probable that the low nitrogen content of the desorbed gas was due to retention as iron nitride. There was no indication, however, that other absorbed gases—*e.g.*, those containing oxygen—were held in chemical combination to any considerable extent. The evidence was distinctly against such a supposition.

Mineral Surveying from the Air

A party of eight explorers, led by Major C. K. Cochran Patrick, of the Aircraft Operating Co., recently left for Africa. The party has gone out to survey 20,000 square miles of unmapped territory in Northern Rhodesia for the Rhodesian Congo Border Concession. The survey will be made from aeroplanes, from which photographs will be taken by means of specially constructed electric cameras. It is believed that rich veins of copper exist in the area which is to be examined, and in view of the difficulty of exploring such a district (much of it being jungle land) the results will be awaited with interest.

Hardening Steel with Nitrogen

Recent messages from Germany state that Krupps are developing the method of hardening steel by heating it in nitrogen, especially in the case of engine parts made of tough steel. It is pointed out that the normal process for hardening such parts is case-hardening.

The new process is described as a surface treatment, that is, case-hardening by nitrogen. The parts to be hardened are heated in an atmosphere of the gas to a temperature of less than 1000° F. No subsequent quenching is required, and it is said that no strain or warping is liable to occur. Any strains existing before the hardening are removed by annealing up to 1050° F. before machining. The volume of the steel is said to be increased to a definite amount by the absorbed nitrogen, and account of this is taken in the final machined size.

Case-hardening cannot apparently be replaced by the new process for all purposes, because the depth of the effect of the latter is smaller, being, as regards the maximum hardening effect, only about 0·3 mm. The process is therefore used only for such parts as have to withstand in use a pressure of less than 45 tons per sq. in. The resistance to wear obtained through nitrogen case-hardening is claimed to be excellent, and parts so hardened are said to be particularly suitable for uses in which it is important that the dimensions shall be varied by friction as little as possible. A further advantage claimed for the process is that the parts retain their hardness even when heated to 900° F.

Cast Iron Research Association Report

The report of the British Cast Iron Research Association for the year 1925–26 has recently been issued. The year concludes the first period during which grant aid was guaranteed the Association by H.M. Government. In accordance with its usual practice, the Department of Scientific and Industrial Research arranged for a group of impartial experts to act as inspectors in examining the organisation and work of the Association. The inspection took place in January, 1925, and the report presented by the inspectors was, by courtesy of the Department, circulated to members. The Council through its sub-committee presented to the Department a memorandum appealing for further assistance, and immediately prior to the end of the financial year, as a consequence of the favourable recommendations made by the inspectors, negotiations were completed whereby further grant aid was assured the Association for another period of five years. Investigations are conducted at the laboratory of the Association (at 24, St. Paul's Square, Birmingham), at several universities, and at the National Physical Laboratory, and an imposing list of the researches now in progress is given in Appendix III of the report. The number of members is given as 219, the total income being £8,460, and the total expenditure £8,811, 74 per cent. of which is spent directly on research. Up to the date of publication of the report 23 research reports had been published.

Copper in Canada in 1926

Copper production from Canadian ores during the first half of 1926 amounted to 70,843,426 pounds valued at $9,757,265, as compared with 53,055,349 pounds valued at $7,354,533 for the first six months of 1925. This was an increase in quantity of 17,788,077 pounds and in value of $2,402,732. New York prices for copper for the first six months of this year averaged 13·773 cents per pound, ranging from 13·999 cents in February, the highest price, to 13·599 cents in May, the lowest quotation, the price in June being 13·656 cents. Copper in commercial quantities occurs in the Yukon Territory, British Columbia, Manitoba, Ontario and Quebec. No production of this metal was reported from the Yukon or Manitoba during the first half of the year. In British Columbia the production amounted to 45,571,429 pounds. Large deposits occur in northern Manitoba, and considerable experimental work is being carried on with a view to the proper metallurgical treatment of the ore. In Ontario copper is obtained mainly from the nickel-copper mines of the Sudbury district, where it is smelted to a matte. Some of this matte is exported to Wales and some to the United States, and the remainder is blown to converter copper at Port Colborne. In Quebec there was a small production from the copper-bearing pyrite ores of the Eustis Mine, but a much greater production will be shown when the new Rouyn district of that province is more fully developed. It is understood that the foundations are now being laid for a smelter and when the railroad that is now projected reaches this new camp, the smelter construction will be rapidly completed.

November Output Figures for Iron and Steel

The output figures for November show the beginning of the return to production by the steel works. There were two more furnaces in blast at the end of the month than at the beginning, and the production of pig-iron amounted to 12,700 tons. Steel production amounted to 97,500 tons. December figures are sure to be much better, but it will be January or February before the figures are such as can be usefully compared with the pre-strike figures.

Many large contracts have been placed recently which mean more work for the steel makers. Shipbuilding, engineering and constructional work, and railway work are included. All this will help on the movement started by the accumulation of work in the strike. One of the best contracts is that secured by the Metropolitan Vickers Co. for the electrification of the Southern Railway's suburban system. It is good news for Sheffield and Manchester, and in Sheffield particularly will mean considerably increased employment.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

The end of the coal strike, inglorious as it was, seems almost to have passed into forgetfulness, and industry generally is beginning to make a move towards the resumption of normal activity. But it is a slow process. Many people appear to think that as soon as a strike is ended ordinary conditions can at once be restored, but it never is so, particularly in the case of a prolonged strike of such dimensions and of such national application as the recent one.

After-effects of the Strike

The prevalence of this erroneous idea is evidenced by the number of letters which are received by the steel works in which surprise is expressed that deliveries of steel are not at once forthcoming now the strike is over. The strike may be over, but its effects are still very much with us. In many cases even the collieries are not yet properly at work. There are minor difficulties in the pits, and on the surface there is the shortage of wagons. Much of the coal that is being produced cannot be despatched because no wagons are available, and the consequence is that short time is being worked at many of the pits. One miner was heard complaining that he had left home each morning at half-past four to go to his work, and on four out of the five days he had to come home again solely on account of this wagon shortage.

Complaints are levelled against the railways and against the Government for this state of things, but it is only one of the many instances of the evil after-effects of the strike. One fact may be mentioned which explains this position, and which may not be generally known. During the stoppage the railway companies, like other industries in the country, were obliged to purchase supplies of coal from abroad, and these supplies could only be obtained by making forward contracts for considerable quantities. Although the strike is ended, there are still large deliveries of coal to be taken against these contracts, and it was reported that about a week ago 20,000 wagons were required at the East Coast ports to convey the coal which was coming in from abroad. No wonder that there is a scarcity of wagons for the home collieries!

Coal Prices

There is a good deal of variation in the reports regarding the price of coal. Statements are made that coal prices are weakening and that they will soon be back to the pre-strike level, but it is difficult to accept that opinion. True, there is not a large volume of actual business in coal at present, as so many of the works are not yet in a position to take supplies, but there is quite a lot of forward buying for next year, and in every case the collieries are insisting upon an advance of 1s. 6d. to 2s. 3d. per ton, and that for a six months contract; and if only a three months contract is wanted a still higher price is asked. It may be, as some think, that by the end of the six months the price will have receded to what it was before the stoppage, but there are those qualified to judge who predict the maintenance of the advance or even higher prices for at least twelve months.

The collieries are strengthened in their attitude by the knowledge that the demand for some months will be very brisk, as all the steel works will be at full output for some months ahead. Moreover, the demand for abroad is likely to increase, as the stoppage has shown many of the foreign consumers that after all there is no coal equal to ours. Then, again, the colliery wages are likely to be unusually high for the next period, as the ascertainment on which they will be based includes the high selling prices which have been realised during the coal famine by those pits which were able to reopen before the strike was ended. It is only natural that the colliery owners will seek to recoup themselves as much as possible in the price of the coal.

The Coke Problem

As far as the iron and steel trade is concerned, the problem at the moment is not only coal but coke, and the latter is the more pressing. There is an insistent demand for coke for restarting the blast furnaces, but only in exceptional cases are prompt supplies available, and unless the works have sufficient stocks in hand they have perforce to wait until the coke ovens are in something like normal operation. This means two to three weeks after supplies of slack are available. The first week gives a poor quality of coke and a very small output; the second week shows an improvement in both respects; in the third something approaching normal conditions is reached. Consequently, many of the coke ovens are unable to promise regular deliveries for the blast furnaces until the first or second week in January. It will, therefore, be about the middle of January before there is a general resumption of work. The hematite iron makers are in a similar position, and already there is rather a scramble for supplies of hematite for the steel works.

Effect on Steel Prices

As might be expected, this demand for coke has had its influence on the price, and the advance exceeds that which has been asked for coal. The present price ranges from 18s. to 20s. at the ovens for three months contracts; indeed, some of the makers are asking considerably over 20s., but such a price can hardly be maintained. The coke market is really in a stronger position than coal. The demand is in excess of the actual supply at the moment and is likely to remain good, as the pig-iron requirements for some months ahead are bound to be greater than they have been for a long time past. It has long been predicted that when the steel works are really busy there will be a shortage of pig-iron, and that condition is about to be reached, as the steel works will be at full stretch to cope with the orders which have accumulated during the stoppage and which are still coming in. More and more iron will be wanted and more coke must be obtained to keep the blast furnaces going. That condition may or may not be long maintained, but it is going to be there for the next few months, and the coke makers are not blind to the fact. It must be remembered that the price at which coke was sold prior to the strike was notoriously unprofitable, and the makers will certainly take advantage of this opportunity to put the trade on a more economical basis.

The advance in the price of coal and coke will mean about 10s. per ton increase in the cost of steel making, even to those works which have their own blast furnaces; and to those works, of which there are still a number, which have to buy their pig-iron, the increase will be still more, as the price of basic pig-iron has advanced 15s. to 20s. per ton. Even the 10s. increase will be a serious matter to the steel makers, and it is rather disconcerting to find that as a result of the coal strike there has to be this increase in manufacturing costs due to the higher price of fuel, when the ostensible purpose of the stoppage, from the masters' point of view, was to make cheaper fuel possible. More than ever cheap fuel is a necessity to the steel trade, but it will be some time before that desire is realised.

No Advance at Present

Steel prices have not yet settled down. The associated makers had a further meeting quite recently and decided not to make any official advance at present, as far as the home trade is concerned, although some of the export prices were increased 5s. This means that the home prices remain nominally at the 10s. over pre-strike prices. At present, the makers are not adhering to this level, and anything from 7s. 6d. to 15s. per ton above is being quoted. So long as these better prices can be maintained, all well and good, but the difference between them and the official prices leaves open the way for under-quoting, and one has misgivings about the length of time that will elapse before the official prices become the actual. Rapid increases are not wanted, and boom conditions still less, but the parlous state of so many of the steel works is surely sufficient argument against the continuation of the policy of selling below cost. Hopes are pinned on the activity of the steel works in the opening months of the new year for a definite revival in the industry, but it is difficult to get away from the fact that there are still too many competing works in this country; and the promised entry in the market of the new steel works at Appleby, which will very shortly be ready for starting, with a possible output of 4,000 tons of finished steel per week, does not make the outlook any brighter. However, it will be easier to discuss the situation when the abnormal conditions created by the coal strike have subsided.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Coating Iron with Lead

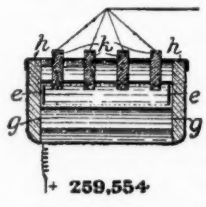
ACCORDING to Dr. O. Spengler, Dessau in Anhalt, Germany, cast iron can be more readily coated with lead if, after pickling, it is treated with a salt of a metal which is precipitated by cast iron; copper sulphate may be used, the iron being covered with a coating of copper to which the lead may be applied by the usual methods, for example, by treatment with a solution containing a zinc halide and a tin salt, heating by means of a blow-pipe, and applying the lead. See Patent No. 260,452, having the date, January 15, 1926.

Lead Alloys

ACCORDING to a patent application by W. Mathesius and M. W. Neufeld, Charlottenburg, Germany, a lead alloy for bearings contains small amounts of the following metals, the proportions indicated being suitable: calcium 0·5 per cent., sodium 0·5 per cent., barium 0·1 per cent., magnesium 0·1 per cent., and aluminium 0·04 per cent. See Patent Application 259,211, having the International Convention date, October 1, 1925.

Electrolytic Methods

IN the electrolytic refining of magnesium or other metals there is employed an electrolyte of molten chlorides, compounded so as to have a density lower than that of the alloy to be refined and higher than the magnesium, etc., which separates at the cathode. The anode, electrolyte, and cathode thus form successive layers, the cathode being further protected by a still lighter layer of molten chlorides. For refining magnesium, a cast iron shell having a refractory lining *g* is provided with a cylindrical sheet *e* of a metal miscible with magnesium and at the level of the cathode layer; it is intended to prevent the creeping along the walls of the upper and lower chloride layers, and may form the cathode connection; the latter may alternatively be made through rods *k* of carbon or iron. An air-tight cover *h* closes the cell. The anode consists of an alloy of magnesium and lead, the electrolyte of a mixture of magnesium chloride and barium chloride, and the protective layer of a mixture of potassium chloride and magnesium or sodium chloride. See Patent Application 259,554 (A. C. Jessup, 12, Square Desnouettes, Paris), having the International Convention date, October 9, 1925.



259,554

Wrought Iron

ACCORDING to a patent by G. G. Gedda, Surahammar, Sweden, a wrought iron of improved tensile strength and raised elastic limit, but which retains almost unimpaired its capacity for being welded, can be obtained by adding a small proportion of nickel or cobalt, with or without a little copper, to the pig iron used in the ordinary processes of manufacture. The composition and mechanical properties of a Lancashire bloom so produced are described. See Patent No. 260,789, having the date November 28, 1925.

E. F. BLESSING describes a process for the production of wrought iron by the puddling process, according to which the charge of iron is first worked with an oxidising slag or reagent while spread out in a comparatively thin layer; when the carbon has been more or less completely removed, but before the iron has become welded together, the charge is crowded more and more together until finally balling takes place. Figure 1 shows a side elevation of a suitable form of apparatus and Fig. 2 a vertical section of Fig. 1, but in the reversed position. The furnace 10 having a lining 11 can be heated by burners 18 and is supplied with trunnions 13, 14, and a door 19. The parts 22, 23 and 24 of the furnace are of diminishing radii 22^1, 23^1, and 24^1. The charge of molten iron and oxidising slag is introduced on to the part 22, where it forms a thin layer and is thoroughly agitated by rocking the furnace about the trunnions 13 and 14; as the action progresses the material is successively transferred to the parts 23 and 24 by rotating the furnace, thus becoming collected into a thicker layer; finally it is transferred to the hemispherical portion 25 where balling takes place, additional heat being simultaneously supplied. The ball of iron is finally removed

Fig. 1.

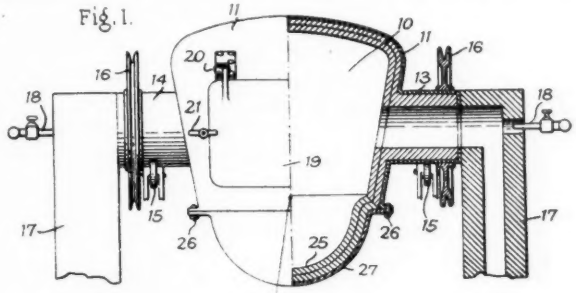
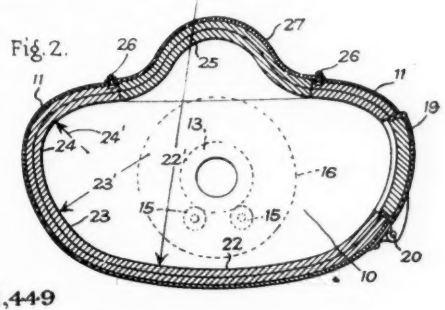


Fig. 2.



261,449

through the door 19 or by detaching the portion 25 of the furnace. See Patent No. 261,449, having the date July 17, 1925.

Purifying Iron

S. WESTBERG, Pittsburgh, U.S.A., describes a process for removing impurities such as sulphur, phosphorus and oxygen from iron or iron alloys by heating the metal in an air-free atmosphere containing hydrogen, and in the presence of a substance which will combine with the impurities or the products of their combination with hydrogen. These substances may be oxides of alkaline earth metals, which combine with sulphuretted hydrogen, phosphine, etc., or they may be metals or alloys such as silicides of aluminium, calcium, barium, strontium, or magnesium, which react with the sulphuretted hydrogen, etc., with regeneration of hydrogen. A mixture of an alkaline earth oxide and a regenerative agent such as aluminium silicide can advantageously be employed. The material to be treated is packed in suitable heating chambers, together with the purifying agents, and is so arranged that the hydrogen has access to all parts of it. Temperatures between 800° and 1,400° C. are suitable. See Patent No. 260,646, having the date June 2, 1925.

Cast Steel

STEEL castings and ingots are poured from an ordinary steel, such as a carbon steel, to which has been added from 0·5 to 5 per cent. of copper. The castings are then "normalised" by heating to a high temperature, say about 1,550° F., for a short time, cooling in air, reheating to about 1,000° F., and finally cooling off. The reheating process effects a considerable improvement in the yield point, ultimate strength, and hardness of the casting, which is not usually the case when an ordinary carbon or alloy steel is so treated. See Patent No. 260,835 (H. B. Kinnear, Marion, Ohio, U.S.A.), having the date March 2, 1926.

Vanadium

B. F. KJELLBERG, of Stockholm, Sweden, finds that vanadium can be more readily extracted from iron ores containing vanadium and titanium if a preliminary roasting is given, but only to such an extent that the compound $FeO.V_2O_3$ is decomposed without complete oxidation of the V_2O_3 to V_2O_5 occurring. The vanadium can then be almost completely extracted by means of hydrochloric or sulphuric acid. The transformation of the vanadium into soluble form is facilitated by an addition of a halogen compound such as sodium, calcium, or magnesium chloride, or fluorspar, at the roasting stage. The vanadium-bearing material is advantageously treated as a finely divided concentrate. See Patent No. 260,661, having the date July 30, 1925.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—What do we know about copper-nickel alloys? M. G. Corson. *Metal Ind. (New York)*, December, 1926, pp. 492-496.

The copper-beryllium alloys. M. G. Corson. *Metal Ind.*, December 31, 1926, pp. 623-624.

The production of "tin alloy" from bearing metal scrap. E. R. Thews. *Continental Met. and Chem. Eng.*, December, 1926, pp. 134-136.

ALUMINIUM BRONZE.—Aluminium bronze; an acid-resisting material. W. M. Corse. *Trans. Amer. Soc. Steel Treating*, December, 1926, pp. 898-906.

CHROMIUM PLATING.—Chromium plating. A comprehensive view of the situation now existing. W. Blum. *Brass World*, December, 1926, pp. 381-383.

CORROSION.—The problem of acid-resistant metallic materials. W. Guertler. *Zeits. Metallkunde*, December, 1926, pp. 365-376 (in German).

Chemically resistant alloys and their properties. E. H. Schultz and W. Jenge. *Zeits. Metallkunde*, December, 1926, pp. 377-386 (in German).

Acid-resistant alloys with nickel as a basis. W. Rohn. *Zeits. Metallkunde*, December, 1926, pp. 387-396 (in German).

CRYSTALS.—Experiments on the production of large copper crystals. H. C. H. Carpenter and S. Tamura. *Roy. Soc. Proc. A*, November, 1926, pp. 28-43.

The formation of twinned metallic crystals. H. C. H. Carpenter and S. Tamura. *Roy. Soc. Proc. A.*, November, 1926, pp. 161-182.

DIFFUSION OF METALS.—The diffusion of zinc in the α-series of solid solution in copper. J. S. Dunn. *Chem. Soc. Trans.*, December, 1926, pp. 2973-2979.

ELECTROPLATING.—Electroplating tin. C. H. Procter. *Metal Ind. (New York)*, December, 1926, pp. 502-503.

The acidity of certain electroplating solutions. A. W. Hothersall. *Metal Ind.*, December 31, 1926, pp. 625-627.

GENERAL.—A rapid method for the heat treatment of the aluminium-copper-nickel-magnesium (piston) alloy. S. Daniels. *Trans. Amer. Soc. Steel Treating*, December, 1926, pp. 872-883.

The action of zinc, tin, aluminium, and magnesium on copper containing copper oxide. O. Bauer and H. Arndt. *Giesserei-Zeitung*, December 15, 1926, pp. 671-677.

The application of technical control to the metal rolling mill. W. B. Price. *Metal Ind. (New York)*, December, 1926, pp. 497-499.

Cyanide Brittleness. V. E. Hillman and E. D. Clarke. *Trans. Amer. Soc. Steel Treating*, December, 1926, pp. 954-965.

The desulphurising action of fluorine compounds on molten iron. W. Wilke-Dorfürt and H. Buchholz. *Stahl und Eisen*, December 23, 1926, pp. 1817-1820 (in German).

On modern reduction rolling mills (continued). G. B. Lobkowitz. *Continental Met. and Chem. Eng.*, December, 1926, pp. 137-138.

Desulphurisation. E. J. Lowry. *Trans. Amer. Soc. Steel Treating*, December, 1926, pp. 906-941.

The thermal expansion of inter-metallic compounds. M. de Hemptinne. *Bull. Classe de Sciences (Acad. Belgique)*, No. 10, 1926, pp. 797-800 (in French).

Electric iron has close grain. *Foundry*, November 15, 1926, pp. 909-910. An account of alloy cast iron made in the electric furnace.

NON-FERROUS METALS.—Modern research in the domain of non-ferrous metals, especially the light metals. A. Petersen. *Naturwissenschaften*, November, 1926, pp. 1049-1059 (in German).

SOLID MERCURY.—The metallography of solid mercury and the amalgams. W. Rosenhain and A. J. Murphy. *Roy. Soc. Proc. A.*, November, 1926, pp. 1-6.

SYSTEMS AND DIAGRAMS.—The iron-molybdenum system. W. P. Sykes, *Trans. Amer. Soc. Steel Treating*, December, 1926, pp. 839-872.

The germanium-aluminium diagram. W. Kroll. *Metall. und Erz*, December 2, 1926, pp. 682-684 (in German).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an*—followed by the date of the Summary, but such total may have been reduced.*]

ILSLEY BROS. AND CLEVELAND, LTD., Birmingham, metal rollers. Registered December 16, £5,000 mortgage, to H. R. S. Ilsley, 5, Church Lane, Aston, coal merchant; charged on Parkfield Works, Parkfield Road, Saltley.

NEW CHUQUITAMBO GOLD MINES, LTD., London, E.C. Registered December 14, £5,000 debentures and bonus of 5 per cent. (filed under sec. 93 (3) of the Companies (Consolidation) Act, 1908), present issue £2,500; general charge. *£6,700. December 31, 1925.

SHEEPBRIDGE COAL AND IRON CO., LTD.—Registered December 6, £1,400 debentures, part of £750,000; general charge (excluding uncalled capital). *£531,950. October 12, 1925.

SMITH AND DAVIS, LTD., Birmingham, brassfounders. Registered November 17, £8,000 debenture, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; charged on land at Birmingham, also general charge. *£22,000. February 23, 1926.

SOUTHERN FOUNDRIES (1926), LTD., Croydon. Registered December 7, £50,000 debentures; general charge.

Satisfaction

CARGO FLEET IRON CO., LTD. Satisfaction registered December 15, £12,500, part of amount registered January 23, 1905, etc.

GENERAL IRON FOUNDRY CO., LTD., London, E.C. Satisfaction registered December 11, £500, part of amount registered October 26, 1923.

INTERNATIONAL ALUMINIUM CO., LTD. (late PANXITE REFINING CO., LTD.), London, S.W. Satisfaction registered December 16, £10,000, registered September 26, 1911, and December 1, 1911.

Nickel or Copper Coinage

THE question of the relative advantages of nickel or copper as metals for coinage has been raised by Mr. T. H. Turner, of the department of metallurgy of the University of Birmingham, in a letter to *The Times*, in which he says: "Why are we bound to continue the use of that clumsy, unhygienic, and wasteful form of coinage, copper money? Copper, as is well known by the excellent metallurgists at the Mint, is one of the metals produced mainly outside the British Empire, the larger proportion of it being bought from the United States. Nickel, on the other hand, is almost an Empire monopoly. It produces beautiful, hard-wearing, and cleanly coins which it is almost impossible to counterfeit, and which suffer practically no loss of their metallic value in circulation. There can be no question that these smaller nickel coins are very much more convenient in use. The rather obvious objection which will be made to any change in the form of coinage by manufacturers or users of penny-in-the-slot machines should not condemn the British nation to the perpetual usage of an effete coinage when every other important State in the world has adopted the far superior nickel coinage."

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Some Notes on the Analysis of Steels

By W. Singleton

(Of the Research Laboratories of the General Electric Co., Ltd.)

The methods of analysis described below are principally for the determination of chromium, manganese, molybdenum, and small amounts of copper when present in steel. They consist for the most part of modifications of existing methods, and are of particular interest because of their rapidity and ease of operation.

Determination of Chromium

BARBA'S method for the determination of chromium in steel may be modified to give very quick and accurate results. The procedure to be adopted may be described as follows. One gram of the steel drillings is dissolved in 20 c.c. of hot 20 per cent. sulphuric acid, and while still hot concentrated nitric acid is added a drop at a time, until the iron present is completely oxidised, as indicated by nitrous fumes being no longer evolved. The solution is diluted to about 200 c.c. with distilled water, heated to boiling, and a concentrated solution of potassium permanganate added until excess is indicated by the formation of a pink colour. The solution is boiled for a few minutes on the hot plate, after which the sides of the beaker and cover glass are washed, and 5 c.c. of a 5 per cent. manganese sulphate solution added. The liquid is thoroughly stirred, and made alkaline with a slight excess of ammonium hydroxide. The precipitate of manganese hydroxide which is thus thrown down instantly destroys the excess potassium permanganate and obviates the long period of boiling required in the use of Barba's method. The solution is rapidly cooled, an excess of dilute sulphuric acid added, and the liquid diluted to a known volume of, say, 250 c.c. After thoroughly stirring, the solution is filtered through a dry filter paper. An aliquot portion—200 c.c. is a convenient volume—is measured into a beaker, an excess of standardised ferrous sulphate solution added, and the solution titrated back with standard potassium permanganate solution. The iron value of the permanganate multiplied by the factor 0·31 gives the chromium value. Instead of diluting the solution to a definite volume and taking an aliquot portion, the whole of the solution may be filtered and the paper washed with hot water.

Terni and Malaguti (*Giorn. chim. ind. applicata*, 2, 559 (1920)) describe a method for the detection and estimation of chromium which they state gives very exact results, the time necessary for a complete determination of chromium being 30 minutes. The quantitative determination of chromium by this method may be made in the presence of iron, manganese, nickel, vanadium, tungsten, and molybdenum, which do not interfere. For the determination of chromium, one gram of the metal in the form of drillings is treated with 30 c.c. of dilute 35 per cent. nitric acid in a covered beaker of 250 c.c. capacity, and the liquid heated until evolution of nitrous fumes has almost ceased. 20 c.c. of concentrated nitric acid and about 1 g. of lead dioxide are added. The boiling of the solution is continued until the volume of the liquid is about 5 c.c. The solution is then removed from the hot plate, and is diluted with about 30 c.c. of cold distilled water, 25 c.c. of 30 per cent. sodium hydroxide are added, and the solution again heated to incipient boiling. The solution, together with the washings from the beaker, is transferred to a graduated 500 c.c. flask, rapidly cooled under running water, and diluted with water to the 500 c.c. mark. After shaking, the solution is filtered through a large pleated paper. 200 c.c. of the solution (corresponding to 0·4 g. of steel) are measured into a 1,000 c.c. conical flask, 25 c.c. of 30 per cent. nitric acid (freed from nitrous acid by prolonged boiling) and 5 to 10 c.c. of a 10 per cent. solution of potassium iodide are added. The liquid is then titrated with sodium thiosulphate solution of 2·5 per cent. strength which has been standardised against N/10 potassium dichromate solution.

Steels with Less than 2 per cent. Chromium

The following method (Cramer, *Chem. Analyst*, 13, 16 (1925)) for the determination of chromium has been found to give accurate results on chromium-nickel and chromium-molybdenum steels of a chromium content of 2 per cent. or less. It has the advantage of being a rapid method and is quite as accurate as the usual procedure. On metals readily soluble in sulphuric acid, a determination can be made in very short time. One gram of the sample is dissolved in 50 c.c. of 20 per cent. sulphuric acid and 5 c.c. of nitric acid (sp. gr. 1·20) are added. 20 c.c. of a 20 per cent. solution of ammonium phosphate are added, and the solution diluted with hot water to 150 c.c. A 5 per cent. solution of potassium permanganate is added a drop at a time until a slight excess remains after boiling two minutes. After the addition of 5 c.c. of 50 per cent. hydrochloric acid, the boiling is continued for three minutes after the pink permanganate colour disappears. If care is taken to add only a very slight excess of potassium permanganate, the manganese will not be precipitated, and the excess potassium permanganate will be reduced immediately on adding the hydrochloric acid. The solution is diluted to 500 c.c. with cold water and titrated with ferrous ammonium sulphate and potassium permanganate.

In titrating chromium with potassium permanganate solution after reduction with ferrous sulphate and when the beaker stands out against a white background, an appreciable excess of permanganate solution is required before the pink coloration of the permanganate can be detected, on account of the intense green colour due to the presence of chromium. According to Kimber (*Chem. Analyst*, 42, 12 (1924)), the pink of the permanganate shows up distinctly by using a black background in preference to white. This difference is so marked that it requires about half a c.c. of the permanganate solution additional to develop the same colour with the white background.

Appelbaum (*Chem. Analyst*, 24, 24 (1918)) suggests the following modification of the previously described method for the rapid determination of chromium in steel. Dissolve 3 g. of the steel drillings in 100 c.c. of 20 per cent. sulphuric acid; a crystal or two of ammonium persulphate will hasten the reaction. The iron is oxidised with concentrated nitric acid, and after boiling for one minute 10 c.c. of a 5 per cent. solution of silver nitrate are added. After removing from the hot-plate, crystals of ammonium persulphate are added until all the chromium is oxidised, as shown by the manganese being converted to permanganic acid. The solution is boiled until all the ammonium persulphate is decomposed. The permanganic acid is then removed by the addition of 5 per cent. sodium chloride until the pink colour disappears, care being taken to avoid excess of sodium chloride. The solution is cooled and excess ferrous sulphate solution added, and the titration completed with potassium permanganate solution. The ferrous sulphate and potassium permanganate solutions are standardised against a known sample of chromium steel. The author states that two determinations made simultaneously will check within 0·02 per cent.

Determination of Manganese

The colorimetric determination of manganese by the persulphate method has the advantage that it is not necessary to remove the excess of persulphate. If the white light is first passed through a filter consisting of a nickel sulphate solution before reaching the permanganate coloured solution, it is easier to determine the depth of colour than when white light is used directly in the colorimeter. Colorimetric determinations of manganese in steel by this method agree within a half per cent. of the total manganese content.

Nelson and Finlayson (*Chem. Analyst*, 40, 18 (1923)) have suggested a modification of the bismuthate method for the determination of manganese in steel, which is claimed to be a speedy and accurate substitute for the long-accepted bismuthate method for manganese in steel laboratory routine. One gram of the steel drillings are dissolved in 35 c.c. of 40 per cent. nitric acid and boiled until solution is complete, and all nitrous fumes have been expelled. After cooling the solution a slight excess of sodium bismuthate is added and the liquid thoroughly stirred. The permanganic acid solution so formed is diluted with 50 c.c. of 3 per cent. nitric acid and filtered through an asbestos filter. The filtrate may then be titrated directly against standard ferrous sulphate solution until the pink colour disappears, a drop of a saturated solution of potassium ferricyanide is added, and the titration continued until the appearance of a distinct green end-point. That the end-point is green rather than blue is due to the complementary nature of the yellow of ferric iron and the Turnbull blue of the indicator. The saving in time to the steel analyst is appreciable. Moreover, there is an approximate secondary end-point (the fading of the pink due to permanganic acid) to which it is possible to titrate rapidly, and a final exact end-point which turns from yellow to green with a single drop of ferrous sulphate solution of the usually accepted concentration.

The Bismuthate Method for Manganese

In an exhaustive series of tests (*Stahl u. Eisen*, 37, 197 (1917)) upon the bismuthate method for the determination of manganese in steel, pure iron manganese nitrate solutions were oxidised with bismuth tetroxide or sodium bismuthate in a 1·5 per cent. solution of nitric acid at various temperatures. It was found that to avoid low results it is necessary to keep the temperature of the solution below 25° C. The resulting permanganate solution was filtered from the excess bismuthate and titrated with hydrogen peroxide, ferrous sulphate, or arsenious oxide solutions. Of these reagents the first was found to be the least practicable because of its instability, but the arsenious oxide was very stable and wholly practicable. In the bismuthate method of determination the presence of chromium was found to give results slightly too high, whilst cobalt, if present, gave slightly low results. The difficulty of completely oxidising the carbon and phosphorus contents in the cold may be remedied by a preliminary warming with a small amount of bismuthate. The manganese dioxide precipitate thus produced is dissolved in the boiling solution, which is then cooled and the main oxidation performed in the cold.

It is claimed by some that the method previously elaborated as well as the lead peroxide and persulphate methods which have also been investigated by the previously mentioned author, are rather too complicated for routine control, and that they offer no advantage over the Volhard method. The Volhard-Wolff method using potassium permanganate can be used in the examination of ores, raw iron, steel and ferro-manganese. It can be used equally well in hydrochloric or nitric acid solutions, but sulphuric acid solutions are to be avoided. The presence of chromium is immaterial if the precipitated zinc oxide is removed. Molybdenum and vanadium do not interfere, but cobalt gives slightly high results. The chlorate process can only be used in nitric acid solution, and is particularly suitable for the determination of manganese in iron and steel. It is less accurate for estimating small amounts of manganese and for ferro-manganese, and the presence of considerable quantities of chromium causes slightly high results. The persulphate method for the determination of manganese is adapted to works laboratory practice because of its rapidity, but the presence of considerable amounts of chromium or cobalt make the end-point of the reaction difficult to detect owing to the colour which these metals impart to the solution.

Determination of Molybdenum

In the usual volumetric method for the determination of molybdenum, the sulphide precipitate is dissolved with nitric acid and sodium chlorate, evaporated with sulphuric acid, reduced with zinc and titrated with permanganate. The presence of iron in the sulphide precipitate may frequently be the cause of high results. If chromium is present it is frequently necessary to filter off and fuse insoluble carbides, thus considerably extending the time required for analysis. In the method described below, the iron and chromium, as well as traces of copper which are often present, are removed by filtration after fusing the ignited sulphide precipitate. This method is more rapid and as accurate as the former method. 3 g. of steel drillings are dissolved in 200 c.c. of 3 per cent. sulphuric acid, ammonium persulphate being added to the hot solution until the molybdenum is completely dissolved, and the solution just begins to turn brown. The solution is diluted with water to 300 c.c., and allowed to cool, after which hydrogen sulphide is bubbled through for 30 minutes. The precipitate is allowed to settle, filtered, and washed with 2 per cent. sulphuric acid. The paper and precipitate are carefully ignited in a platinum crucible, care being taken to prevent heating above a faint redness. After the addition of 2 g. of sodium carbonate, the ignited sulphides are fused for about three minutes in the covered crucible at a low temperature. The fusion product is dissolved in a small beaker containing 75 c.c. of water, and heated until the solution is complete. The liquid is boiled for a few minutes and filtered into a 250 c.c. beaker. If some of the charred filter paper is left in the crucible during fusion and the air is excluded by the crucible being tightly covered, any chromium present will remain unoxidised and will be precipitated along with the iron and copper by the sodium carbonate. The insoluble matter is filtered off, the filtrate cooled, and 25 c.c. of 50 per cent. sulphuric acid added. After heating to drive off all carbon dioxide, 2 g. of granulated zinc are added to the cool solution. When the zinc is all dissolved, the hot solution is passed through a Jones reductor—containing granulated zinc—into a ferrous sulphate solution, and washed with 2 to 3 per cent. sulphuric acid. The titration is then immediately completed with potassium permanganate. The blank found by dissolving 2 g. sodium carbonate in 75 c.c., and proceeding as with the sample, is deducted.

According to Maag and McCollam (*Ind. Eng. Chem.* 17, 524 (1925)) the determination of 0·02 to 0·15 per cent. of molybdenum in steel can be made in 20 minutes, by taking advantage of the colour reaction between molybdenum trioxide, potassium thiocyanate, and stannous chloride. For further details of the manipulation of this method the reader is referred to the original paper.

Determination of Copper

It is frequently desirable to determine the copper in steels bearing but a few hundredths per cent. The following method is really a combination devised from several other methods, and has been found to give quite satisfactory results. 5 g. of the steel drillings are dissolved in 150 c.c. of 20 per cent. sulphuric acid. Most of the free acid is then neutralised with ammonia solution, and hydrogen sulphide bubbled through the solution until saturated. The residue is filtered off and washed with water containing hydrogen sulphide, and ignited in a porcelain crucible. A small amount of potassium bisulphate is placed in the crucible, and heated just sufficiently to keep the bisulphate in a state of fusion, when the copper will quickly go into solution. The fusion product is dissolved in hot water, transferred to a 200 c.c. Erlenmeyer flask and cooled. The total volume should be about 80 c.c., to which is added 10 c.c. of the standard copper sulphate solution, and sufficient 20 per cent. sodium hydroxide to form a slight precipitate of copper hydroxide. The solution is neutralised with acetic acid and 1 c.c. of concentrated acetic acid added in excess. 20 c.c. of 10 per cent. potassium fluoride to suppress the ionisation of the iron which is always present in small amounts, and 10 c.c. of a 40 per cent. solution of potassium iodide, are added, and the solution thoroughly stirred before being titrated with standard sodium thiosulphate. When the yellow colour of the iodine has almost faded, 3 c.c. of starch solution are added and the titration continued to the slightly cream coloured end-point. 10 c.c. of the standard copper sulphate solution should be titrated under the same conditions as the sample, after the addition

of sodium hydroxide to slight alkalinity, acidification with acetic acid, and the addition of potassium fluoride and potassium iodide.

The addition of the 10 c.c. of standard copper sulphate solution to the sample is necessary, otherwise a sharp end-point will not be obtained. The fusion after ignition with potassium bisulphate has the advantage over dissolving in nitric acid in that nitrous fumes which cause trouble during titration are absent. The standard thiosulphate is made by dissolving 4 g. of that salt per 1,000 c.c. water, which is then standardised against a copper sulphate solution of known copper content. The standard copper sulphate solution is made by dissolving 2 g. of pure metallic copper in nitric acid, adding 15 c.c. concentrated sulphuric acid; the liquid is evaporated to dense white fumes. The solution is taken up with water and diluted to 1,000 c.c.

The Recovery of Tin from Waste Scrap

Advantages of the Chlorine Process

THE high cost of tin, the enormous quantities required for the food-canning and other industries, and the limited supplies in sight, lend peculiar interest to the possibilities of recovering the tin from the vast accumulations of scrap which bear witness to the wonderful increase in the world's consumption of canned foods. Interest in the subject is further deepened by the fact that some of the most successful of the many processes patented in recent years for detinning scrap involve the use of chlorine, a substance now produced in such large quantities that new outlets for its employment are required.

Numerous attempts have been made during the past thirty or forty years to utilise tin scrap, partly for the sake of the iron, but chiefly for the sake of the tin. It has been found that it is not possible to recover the iron without first removing the tin coating, and indeed it is not very rational to try to do so, since the tin itself is so valuable. Hundreds of patents have been taken out for removing this coating, either in the form of metallic tin or as tin salts. The latter, of course, are of value for many technical purposes, and need not necessarily be reduced to metallic tin. The earliest attempts at detinning made use of electrolysis, as in the patents of Keith (1876, U.S.A. Pat. 176,658) and T. Goldschmidt, of Germany, in which the scrap, in warm alkali solution, is subjected to electrolysis, the tin being recovered at the anode and the iron at the cathode. The tin is easily removed and melted down, and the iron also may be compressed into solid billets for which there is a ready market. The method proved fairly successful on a commercial scale, but has now been generally superseded by the chlorine process. A second method is that of detinning with hot aqueous alkaline solution, with or without an oxidising agent. Here the tin is recovered in the form of one of the oxides of tin, and may be used direct as a colouring matter, *e.g.*, in the manufacture of enamel, or it may be smelted down to metallic tin.

The Chlorine Process

The chlorine process of tin recovery dates back to 1854, when Higgins took out a patent (Eng. Pat. 766, 1854), followed by Parmalee and others in the United States. In 1883 there was also a plant working successfully at Metikon, on Lake Zurich, in Switzerland. The most important condition in the chlorine process is that moisture must be rigorously excluded. The chlorine gas must be perfectly dry, and the tin scrap clippings must also be perfectly dry and clean. The temperature must be kept below 38° C. or 100° F., if an iron reaction chamber is used, otherwise the chlorine will attack the iron, forming ferric chloride. This action of the chlorine is also accelerated by the presence of moisture. Even with these conditions strictly fulfilled it was difficult to avoid the formation of rust on the iron scrap. A very thin layer of ferric chloride would persist in forming and would attract moisture from the air, however carefully perfect dryness was provided for. It was therefore necessary to remove this layer of ferric chloride, as formed, by means of washing. Numerous patents have been recently taken out, modifying the practical details of the chlorine process. In Goldschmidt's latest process the dried tin scrap is put into large cylindrical containers, either in a more or less loose form, or pressed into baskets. These containers are tightly closed, and dry chlorine gas is introduced under pressure, either at 3·7 atmospheres at 0° C., or 7·6 atmospheres at 25° C. The pressure continues to fall as detinning proceeds, owing to the formation of liquid tin chloride and consequent reduction in gas volume. When the pressure remains constant detinning is finished. The heat formed during the reaction of the chlorine with the tin is dissipated by cooling.

Another chlorine method is that of Von Schutz, in which a dry mixture of chlorine and other gases, such as dry air, is drawn through the scrap by suction instead of pressure. Arrangements are made for reheating the inflowing gases, if necessary, by passing them through pipes around which the exist gases of the process are drawn off, these exit gases having been heated by the heat of the detinning reaction. By their subsequent cooling and contraction they form the required vacuum for suction. The detinned scrap is washed, dried, and compressed. This method is said to be quicker and simpler, and requires less labour and apparatus than some of the others. Von der Linde has also patented a method in which dry air is mixed with the chlorine.

In other processes, such as that of Dubois and Kaufmann, a solvent is used, *e.g.*, carbon tetrachloride, and the tin salts so produced, together with the solvent, may be recovered by subsequent treatment with water or steam; or, if preferred, the solution of the tin salts in carbon tetrachloride may be electrolysed after addition of water. In the Acker process liquid chlorine, from which free chlorine gas is constantly given off, is used. Von Kugelen and Seward, in patents assigned to the Tin Products Co., of New York, use a process in which the scrap is so arranged that the heat generated during detinning is dissipated rapidly enough to maintain the temperature below the point at which chlorine attacks iron, and the stannic chloride formed is removed by volatilising in a current of chlorine, or is condensed in the detinning chamber. Sperry, and also Leitch, in their patents both use stannic chloride either mixed with chlorine or alternately with it.

It is claimed generally for the chlorine process that it can be carried on in larger units and with lower labour charges, that it is more thorough, and that less tin is lost than when other methods are used. The tin is recovered in the form of tin tetrachloride (*i.e.*, stannic chloride) which is a valuable product extensively used in the silk-dyeing industry. Practically all the corrosion problems have now been satisfactorily solved. The cost of a detinning plant varies from £3 to £4 per ton of scrap handled, when the plant is comparatively small, say, a 1,500 ton per annum capacity, to £2 or £2 10s. per ton of scrap with a larger plant of 10,000 tons per annum capacity. These figures include the necessary buildings and all plant, such as baling presses, cranes, chlorinators, pipe connections and chlorine compressors. Practically the whole cost of the process is covered by the price obtained for the recovered iron billets, whilst the stannic chloride crystals, which may be sold as such, preferably, or reduced to tin, represent clear profit. The process appears therefore to be fairly attractive.

Indian Metal Tariff

THE Government of India has published a Bill giving effect to the main recommendations of the Tariff Board for the continuance of protection of the Indian steel industry for seven years from April 1 in the form, not of bounties on production, which the Tariff Board suggested should be abolished, but of changes in import duties. It is recommended that a statutory inquiry shall be instituted at the end of the protective period to ascertain the amount of protection still necessary and the manner in which it should be applied. The Bill removes the duty on unwrought zinc with a view to reducing the cost of manufacturing galvanised sheets, and also reduces the duty on block tin from 15 per cent. *ad valorem* to 250 rupees per ton. Both of these latter changes are not subject to a seven years' limit.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Modern Fuel Developments

In view of the great importance of the fuel problem at the present time, the metallurgical department of the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, has arranged a special and very comprehensive course of lectures, by a number of specialists, which will deal with some technical aspects of the subject. The lectures will be given on Mondays, from 6 to 7 p.m., commencing on February 7, and the detailed arrangements are as follows: February 7, "Recent Developments in Coal Mining," by H. M. Morgans, B.Sc., M.I.M.M.; February 14, "Preparation of Fuel," by Professor K. N. Moss; February 28, "Pulverised and Colloidal Fuel," by L. C. Harvey; March 7, "Coke Oven Practice," by E. M. Myers; March 14, "Gas Works Practice," by Dr. H. G. Colman; March 21, "Low Temperature Carbonisation," by F. S. Sinnatt, M.Sc., F.I.C., of the Fuel Research Department; March 28, "Liquid Fuel," by Professor J. S. S. Brame. The fee for the full course of seven lectures is ten shillings.

Institute of Metals General Meeting

The annual general meeting of the Institute of Metals will be held in the Hall of the Institute of Mechanical Engineers, Storey's Gate, London, W.1, on March 9 and 10. On March 9, the annual dinner of the Institute will be held at the Trocadero Restaurant, Piccadilly, and this will be followed by a dance. The price of tickets for the dinner and dance is 15s. The programme of the meeting is as follows: Wednesday, March 9—morning, general meeting and reading of papers; afternoon, reading of papers, followed by a discussion on "Electric Furnaces in Non-Ferrous Metallurgy."—Thursday, March 10, morning and afternoon, reading of papers.

Papers before the Meeting

Among the papers to be submitted to the meeting are the following:—Professor K. Honda and Professor H. Endo, "Magnetic Analysis as a Means of Studying the Structure of Non-Magnetic Alloys"; C. Blazey, "Brittleness in Arsenical Copper"; J. D. Grogan, "The Influence of Calcium on Aluminium Containing Silicon." With an Appendix on "The Estimation of Calcium in Aluminium Alloys," by P. G. Ward; Professor D. Hanson and Grace W. Ford, "Investigation of the Effects of Impurities on Copper. Part V.—The Effect of Bismuth on Copper"; Professor D. Hanson and C. B. Marryat, "Investigation of the Effects of Impurities on Copper. Part III.—The Effect of Arsenic on Copper. Part IV.—The Effect of Arsenic plus Oxygen on Copper"; J. N. Friend and W. E. Thorneycroft, "Examination of a Fifteenth Century Brass"; E. Hargreaves, "The Application of Strain Methods to the Investigation of the Structure of Eutectic Alloys"; and "Note on the Crystallisation of the Lead-Tin Eutectic"; R. Genders, "The Mechanism of Inverse Segregation in Alloys," with an Appendix on "The Accurate Determination of Copper in Bronze by Electrolysis," by R. A. F. Hammond; H. Moore and S. Beckinsale, "Notes on the Manufacture and Properties of Hair Springs"; J. H. Miller, "The Penetration of Brass by Tin and Solder, with a Few Notes on the Copper-Tin Equilibrium Diagram"; J. N. Friend and W. E. Thorneycroft, "Note on the Silver Contents of Roman Lead from Folkestone and Richboro' Castle"; D. F. Campbell, "Electric Furnaces in Non-Ferrous Metallurgy"; M. Hansen, "The Magnesium-Rich Magnesium-Copper Alloys."

A New Vista in Metallurgy

There is every indication that we are on the eve of new discoveries in regard to metallurgy, which will profoundly modify many of our chemical and physical concepts. The enormous amount of attention now being devoted to the investigation of pure metals, to which reference has more than once been made in these columns, is having important results. A symposium on pure non-ferrous metals has recently been held in New York under the auspices of the American Electrochemical Society. At this meeting reports were presented showing that degrees of purity have already been reached in the production of copper, aluminium, nickel, zinc, lead, and tin, which but a few years ago would have been regarded as unattainable. The maximum purity is reached in the case of zinc, which has been prepared in a condition of "spectroscopic purity." Cadmium of similar purity is said to have been made. At the symposium samples of copper having 100 per cent. conductivity, the conductivity of a hitherto purely theoretical constant, were exhibited. Even if analyses reported to the 5th place of decimals are taken *cum grano salis*, it is evident that the results obtained in regard to the production of pure metals tend towards theoretical perfection.

New Constants Available

Of the many consequences which may ensue from the production of metals of so great a degree of purity, it will suffice to instance two only, as showing the new fields open to investigation. We shall have a fresh set of constants that will really be constants, and not subject to the vague perturbations due to "foreign constituents." It will be possible to state boiling and freezing points in terms as absolute as those of pure mathematics, and to ascertain other physical data with a definiteness and accuracy hitherto unknown. The relationships of these constants to one another may reveal other fundamental facts respecting the constitution of matter, and smooth out some of the kinks and discrepancies in existing curves of a periodic kind collating physical and chemical data. The other field of investigation thus opened out is of equal importance from the point of view of pure science, and of even greater importance to the applied sciences of metallurgy and engineering. It has hitherto been impossible to give a definite value to the precise influence of each component element in an alloy on the aggregate physical properties. When pure metals, the properties of which have been quantitatively established, are used in the preparation of such alloys, the ultimate properties should be capable of accurate predetermination, and a very great advance will have been made.

Corrosion Problems

Apart from these two main lines of research, the behaviour of pure metals towards solvents, and, in particular, their behaviour in electrolysis should throw a considerable amount of light on many vexed questions concerning the *modus operandi* of corrosion. Already the behaviour of pure zinc to acids has been found to differ enormously from that of *comparatively* pure metal. The phenomena of passivity, and the influence of accelerators and "poisons" in the electrolytic deposition of metals are all, *a priori*, related to certain aspects of corrosion, using the term in the wide sense, and not in the more restricted one of rusting alone. The behaviour of a single specimen of a really pure metal will serve to show to what extent the old electrolytic theory of corrosion, or the newer electrolytic theory can, respectively, be relied upon. Finally, those methods of research which are employed to investigate structure, and X-ray analysis, will be greatly simplified.

The Supersession of Smelting Processes

An interesting point has recently been brought out in one of our American contemporaries in regard to the general campaign for the production of pure metals. Broadly speaking, the purity of a metal produced by ordinary furnace methods depends upon the ease with which its oxides can be reduced by smelting. Thus tin, which can be easily reduced, can be made in a high relative degree of purity. Aluminium is at the other end of the scale, and cannot be directly produced by such methods. Lead, zinc, copper, and iron occupy intermediate positions. The tendency is, therefore, for an alternative process to supersede the furnace process in the case where purity is desired, and the metal cannot easily be reduced. Electrolytic metal may therefore be regarded as an escape from two antagonistic tendencies. One is the exhaustion of high grade ore, which means that more impure ores have to be used, with consequent greater contamination when the older furnace processes are employed, and the other the increasing demand for special and uniform alloys made from metal of the highest purity. The moral to be drawn from these considerations is that the older furnace methods will hold their own in industry whenever ores and fuels of reasonable purity are available, but, as the demand for purer metal grows, and in proportion as the purer ores become exhausted, electrolytic methods will continue to grow in favour.

High Temperature Viscosity of Metals

THE admirable paper by Sir Robert Hadfield, read by Mr. S. Main before the Institute of Marine Engineers, summarises in an interesting way much useful information as to the behaviour of steel, and some of the new heat-resisting alloys at high temperatures. Incidentally, it explains clearly what is meant by the creep stress limit, the new conception which has been introduced in connection with the investigation of the extension of metals, under stress, at high temperatures. The importance of the whole subject to steam and power engineers is further emphasised by an article in the December number of the *Revue de Métallurgie*, by MM. J. Cournot and R. Pages. This article, which is one of a series, deals with the viscosity of copper, brass, and aluminium bronze at high working temperatures. The "creep stress limit" is the stress at and below which, at any particular high temperature, no continuous stretching is produced, however long the load is maintained. The French investigators' "limit of viscosity" is the stress above which continuous viscous deformation takes place. It would appear, therefore, that the two conceptions are identical. Sir Robert discusses steel only, but MM. Cournot and Pages have made experiments on the non-ferrous metals referred to. Among other interesting results it was established that the presence of lead in a brass greatly reduces the limit of viscosity. Above 300° and up to 400° C. copper is stronger than brass; hence, the richer in copper a brass is, the better it will behave at high temperatures. Copper aluminium is superior to either metal. Some viscous flow experiments on these metals at ordinary temperatures are also recorded, and further experiments on aluminium and its alloys are in progress.

Corrosion Prevention by Electrolytic Coating

AT a meeting of the Electroplaters' and Depositors' Technical Society, held at the Northampton Polytechnic Institute, London, on Wednesday, January 19, Mr. H. Sutton, of the Aircraft Station at Farnborough, read a paper on "Electro-Deposited Coatings for Prevention of Corrosion." Dr. R. S. Hutton occupied the chair, and in introducing the speaker roughly compared the efficiency of galvanised zinc with electro-zinc. There could be little doubt, he said, that present-day galvanising was not as good as it once was, and this fact served to enhance further the merits of electrolytic zinc, remarkably thin coats of which gave adequate protection.

Mr. Sutton prefaced his experiences of the rust-resisting properties of various metals with a description of the manner in which rusting occurred. The three important factors were: firstly, the metal; secondly, the moisture deposited as the result of temperature changes; and thirdly, the oxygen of the air which oxidised the ions entering the solution, thus continually removing the iron from the solution to form insoluble hydroxide. One of the best metals for preventing rust was zinc. A thickness of 0·0005 inch gave very good protection, which was not increased materially by thicknesses exceeding this. Cadmium deposits afforded a protection of about the same order as zinc, improved results being obtained by heating to 200° to 300° C. Nickel was definitely inferior to zinc and cadmium, thick deposits being necessary even for moderate protection. Chromium also gave disappointing results, deposits up to 0·0025 inch being ineffective. Tin and lead, though unsatisfactory preventives of corrosion, had been useful on parts which were exposed to various chemicals, *e.g.*, explosives.

Discussion on the Above

A VERY interesting discussion was opened by Mr. S. Wernick, who gave his experience of the comparative protection afforded by zinc obtained from acid and cyanide baths; he stressed the need for a standard corrosion test so as to render results comparable. Mr. W. James stated he had had very satisfactory results with a very thin cadmium plate, while deposited chromium, when polished, gave remarkably good rust protection. Mr. A. E. Ollard indicated that interference on the part of those responsible for finishing specifications, specifying as they did finishes which were easily removed in subsequent operations, resulted in apparent anomalies in regard to the rust-resisting properties of such metals as zinc. Mr. C. H. Humphreys, of the Udylite Process Co., of U.S.A., gave some interesting details of plating practice in America, where, he stated, cadmium had largely superseded zinc, a 0·0002 inch of plating of cadmium being superior to 0·0005 inch of zinc. The different results obtained by various investigators were largely due to the different types of deposit obtainable from a cadmium cyanide bath. The bath was also very sensitive to the presence of impurities, *e.g.*, thallium and lead; it had been found that the presence of as little as 0·001 per cent. of the former was sufficient to change the properties of the deposit.

Copies of Mr. Sutton's paper may be obtained from the secretary of the Electroplaters' and Depositors' Technical Society, Mr. W. E. Harris, 193, Eversleigh Road, Battersea, London, S.W.11. The Society is holding a joint meeting with the London Section of the Institute of Metals at the rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, London, at 7.30 p.m. on February 10, when Mr. W. R. Barclay will speak on the subject of "Nickel Coatings and Methods of Production."

Germany and the Steel Cartel

NEWS from the Continent has lately been indicating that the working of the Steel Cartel is causing some dissatisfaction in Germany. German production is such that the quota fixed has been exceeded, and as a result Germany has been compelled to pay large sums into the international compensation fund for regulating the cartel. The quota of production allowed to the French producers has also given rise to rather bitter criticism in Germany. There are German charges of dumping against the French and Belgian metallurgists, who are accused of having influenced world prices in such a way that the advantages which the cartel had for Germany became of less and less value.

There is a suggestion that the withdrawal of Herr Fritz Thyssen from the Franco-German committee formed at Luxemburg a year ago has not been without its effect on the German attitude. Thanks to the rationalisation of German industry, German steel production has increased considerably. The sum which the German producers have paid into the international fund connected with the cartel is put at 2,690,000 dollars. In these conditions it is pointed out that Germany cannot be expected to have much enthusiasm for the cartel. Notice of withdrawal from the cartel has not yet been given.

New Railway Rates

The new railway rates are now in force, and, unwelcome though they are, the steel makers have no choice but to submit to them. It is certain that the steel makers will have to bear the extra cost, as there has been very little opportunity to provide for the advance, and the amount of the increase in rates is so small on the average individual rate that it can hardly affect the quoted price. Nevertheless, it is computed that the total extra cost to the industry, including carriage on inward materials and on the outgoing steel, will be about 2s. 6d. per ton, which is a serious addition to the burden which the coal strike has imposed. Strenuous efforts have been made to stay the advance in rates as far as the steel trade is concerned, but without avail. As a matter of fact, the railways have been compelled to take this step. It is not generally realised that without the advance there would be great danger of failure to pay the regular interest on the capital invested in the railways, and if this were to happen the railway stocks would no longer be trustee stocks, with the result that there would be a tremendous slump in the value of the stock, which might be a far more serious matter to the country than the advance in rates. It is to be hoped that one effect of the new rates will be to induce the railways to give a little better service, as there has been a decided falling off in this respect since the amalgamations.

Record French Iron Output

FIGURES are now available showing that there was a record production of iron and steel in France in the year 1926. The blast furnaces produced 9,392,000 tons as compared with 8,494,000 tons in 1925. Before the war the annual production of pig iron was 5,200,000 tons, these figures not including the output in Alsace and Lorraine. As to steel, 8,386,000 tons were produced, as against 7,500,000 tons in 1925. France exported last year 700,000 tons of pig iron and 2,000,000 tons of steel. With rails, sheets, etc., a third of her total steel production was exported.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THE month of January has been one of great activity in the steel works. Many of them have been in operation during the whole of the month, others could not get started until about the end of the first week in the month. All of them are now busy overtaking the arrears which have accumulated during the coal strike; indeed, there has been no such high pressure of work since the boom days of 1920, and those works which during the war period greatly increased their productive capacity are now for the first time since then in a position to operate the whole of the plant, and sections of the works which have been idle for some years are once again at work. It is not, however, all smooth sailing.

Fuel Supplies

Fuel supplies are by no means regular, and those works which are dependent on outside supplies are finding great difficulty in obtaining constant deliveries as they are required. Many of the collieries are still unable to work full time owing to the shortage of wagons in which to dispatch the coal as it is raised, and this want of wagons, together with the delays which are taking place in transit from the collieries to the works, is causing a lot of inconvenience to the steel works. There is still a heavy call for wagons to deal with the foreign coal which is coming in against the contracts entered into during the strike, chiefly for railway use, and until these contracts are cleared off it is probable that the wagon trouble will remain more or less acute. Moreover, the railway constructional and repair work was thrown very much behind owing to the difficulty of obtaining materials, and this has intensified the trouble. It is another illustration of the far-reaching effects of industrial disputes, and the miners themselves are having the lesson very forcibly brought home to them. Many of them are working short time as a direct result of the wagon shortage.

Coal and Coke Prices

There is as yet no weakening of the price for coal and coke, nor can that be expected so long as the demand remains as brisk as it is just now. Nevertheless, there is a confident expectation that the market will be much easier before the end of six months, and some of those who are in a position to judge predict that there will be something of a slump in the coal trade by the end of June. It will not be long before the output overtakes the demand, and then lower prices are bound to follow. That this opinion is shared by the colliery owners is proved to some extent by their insistence on a term of six months for contracts for coal supplies which were fixed up at the beginning of the year.

Coke is not in quite the same position. There is a real shortage of coke owing to the increased demand due to the improvement in the pig iron trade, and this is likely to continue. There will, no doubt, be larger supplies available shortly when the new ovens which have been built are put into commission. It is the increased demand which has enabled the coke makers to insist upon a considerably greater increase in price than was obtained for coal. In addition to the requirements for blast furnaces there is a considerable market for coke for other industrial purposes, and two sets of prices have been established for the two classes of consumer. While the price for blast furnace coke is round about 19s. to 20s. at the ovens, the price for other industrial use is 25s. at the ovens. Consequently those coke makers who are finding a strong demand for coke for general use are inclined to take advantage of this higher price, with the result that some of the pig iron makers have to go short. After all, one can hardly blame the coke makers. Their contention is that they have been losing money long enough, and that now there is a chance of making a profit they must avail themselves of it.

Steel Trade Prospects

Although the steel trade is so brisk at present, the forward view taken by the steel makers is none too sanguine. The orders are being worked off at a high rate, and new business is not coming forward in anything like the same proportion. If this condition continues we shall find that in two or three months' time there will be a revival of the keen competition which existed before the strike, with the inevitable fall in prices. It looks very much as though that is the opinion of the market. Buyers are very cautious indeed, and are showing little disposition to book ahead or for any greater quantity than they are compelled to do.

The continental position is also encouraging this attitude. During the strike continental prices rose very considerably, but since the resumption of work here there has been a rapid fall. It is only a natural conclusion on the part of consumers in this country that the effect of this fall in continental prices will be a weakening of the home prices, and it is therefore not surprising that there is little disposition to buy at present. Another point to be remembered is that the accumulation of orders represents a great volume of work for the engineering, constructional, and other industries, and so long as good deliveries of steel are forthcoming the completion of these contracts will to some extent delay the placing of further orders. This comparative scarcity of new business appears to be common to all the steel works, and if it continues the order books will soon begin to look thin.

One curious fact is that notwithstanding that the output of the steel works is reported to be taken up for many weeks ahead, there seems to be little difficulty in getting fairly prompt delivery of new specifications that come on the market, and orders are not secured if late delivery is promised. If all the works are as busy as they profess to be, one is almost forced to the conclusion that they are favouring the new work on account of the higher prices and giving it preference over some of the pre-strike orders.

Birmingham Meeting

The Birmingham quarterly meeting, the first of the year, had no outstanding features. There was quite a good tone, but not much actual business. Prices are still considered too high by the consumers, and this opinion is strengthened by the fact that most works are quoting more than the official association prices. Consequently there was shown at the meeting the tendency to which allusion has already been made, to defer placing new business apart from immediate needs. Although on the whole the market may be regarded as firm, there has been a disposition to shade prices, and it is possible that this movement will be more definite in the near future. There are those who would prefer to keep prices up, and if possible advance them, but this can hardly be done in view of the conditions prevailing, and particularly the continental competition. The formation of the European Cartel has certainly not put a stop to competition from that quarter, and the foreign works are cutting as keenly as ever. It would not be surprising to hear at any time that the Cartel itself has broken down, as it is founded on none too sure a basis.

Pig Iron Market

The pig iron market is fairly good, although prices have receded somewhat, lower rates being quoted for February and March delivery than for January. The output is gradually increasing as more furnaces are put into operation, and lower quotations are the natural result. There is, however, still a good demand for basic iron for the steel works. Hematite is not too brisk just now, although West Coast brands have recently been advanced 1s. 6d. per ton. There is nothing new to report about steel prices. The associated makers had a meeting recently and decided not to alter the prices.

The December production figures show the return towards normal outputs, and the results are quite satisfactory, considering that it was getting on towards the end of the month before work was resumed. There were 78 furnaces in blast, with an output of 98,000 tons. The production of steel ingots was 319,300 tons, which compares with 606,800 tons in December, 1925. The figures for the year 1926 show a total output of 2,441,500 tons of pig iron and 3,560,400 tons of steel, compared with 6,261,700 tons and 7,385,400 tons respectively in 1925. The imports of iron and steel in December were 517,100 tons, which makes the total for the year 3,740,200 tons, the highest yet recorded.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Gold-platinum Alloys

WHEN hard acid-resisting alloys have been required, for example, for the jets used for spinning artificial filaments, platinum-iridium alloys or an alloy of gold with about 10 per cent. of platinum have been used. It is now found that an alloy of gold with 20-32 per cent. of platinum is unusually hard, and the small holes of the spinning jets can readily be drilled therein. Further, the metal does not flow when jets made thereof are heated to bright red heat to remove organic matter. See Patent No. 260,672 (W. P. Dreaper), having the date August 5, 1925.

Magnesium and its Alloys

IT is known that magnesium or magnesium alloys containing small amounts of calcium are hard and are well adapted for autogenous welding. According to a patent by G. Michel, Bagneux (Seine), France, such alloys are advantageously made by adding the calcium to the molten metal in the form of particles which pass a 5-mesh sieve, but are retained by a 50-mesh, this state leading to rapid diffusion of the metal. By employing simultaneously magnesium fluoride as a flux chlorides and oxychlorides are eliminated from the metal, which is then stated to be specially suitable for forging, rolling, etc. See Patent No. 261,528, having the date October 17, 1925.

Blast Furnace Slag

BLAST furnace slag is frequently unsuitable for many purposes owing to its tendency to disintegrate, this being generally due to presence of an excess of lime. A. and J. Crawford, of Nottingham, find that such slag can be improved in this respect by adding thereto while it is still in the molten state a quantity (5 to 7·5 per cent.) of an acid steel slag such as contains silica, ferrous oxide, and manganous oxide. The acid steel slag may be either in the molten state or as a comparatively finely crushed solid. See Patent No. 261,976, having the date March 26, 1926.

Refractory Materials

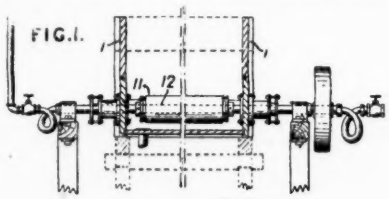
ACCORDING to a patent application by the Borgestad Fabrikker, Borgestad, Norway, artificial magnesium orthosilicate, made by heating at 1,000-1,400° a mixture of calcined magnesite with talc, can be used for making refractory articles or cements. See Patent Application No. 260,298, having the International Convention date October 24, 1925.

Chromium Plating

IN a method described by Siemens and Halske Akt.-Ges., Berlin, the chromic acid electrolyte contains also a foreign metal or metals or compounds thereof which are soluble in chromic acid. Zinc sulphate, lead acetate, and copper or aluminium hydroxide are suitable. See Patent Application No. 259,984, having the International Convention date October 16, 1925.

Froth Flotation Processes

F. P. EGEBERG, Oslo, Norway, describes a flotation apparatus in which the air or other gas is introduced into the pulp through a rotor 11 having porous walls. The latter consist of canvas or other porous material mounted between



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screens 23, 25 supported on slats 20. External vanes 30 are also provided. The gas is admitted through the perforated tube 12. See Patent Application No. 261,395, having the International Convention date November 13, 1925.

Pure Iron

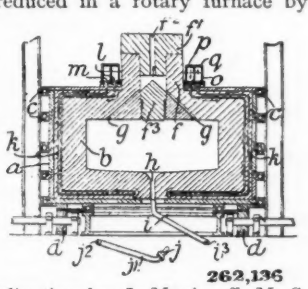
ACCORDING to a patent by J. Y. Johnson, London (communicated from the I.G. Farbenindustrie Akt.-Ges.), pure iron can be prepared by passing vapours of iron carbonyl in a dilute condition over or through heated bodies at a temperature of 100° C. or higher. Such bodies may be small pieces of metal such as iron turnings, or liquids such as molten iron or other metals or oils or melted hydrocarbons of high boiling point such as anthracene, phenanthrene, or paraffin hydrocarbons. The iron carbonyl vapours are diluted either by reducing the pressure or by admixture of inert or reducing gases. The method enables pure iron to be obtained from impure iron or low grade iron ores, or iron ores containing copper and zinc which are only worked up with difficulty in a blast furnace. Examples are given according to which the contact mass consists of iron turnings heated to 250–300° C. or iron fused in a closed crucible furnace heated by an electric arc; the diluent consists of nitrogen.

Alloy Iron and Steel

IT is known that it is often difficult to produce iron and steel containing a high percentage of alloying metal while maintaining a low carbon content, particularly when scrap metal is to be used. According to W. B. Hamilton and T. A. Evans a charge of scrap alloy such as stainless iron or steel is melted in an electric furnace with or without some mild steel, while being covered by a sufficiently large amount of slag; the material for supplying the necessary alloying metal (such as chromite) is then added to the slag together with sufficient reducing agent (such as ferro-silicon) to reduce the ore and also any alloying metal oxidised into the slag during melting. The slag must be sufficiently hot to start and maintain the reducing reaction. Details are given for the production of chromium steels containing 18 and 12 per cent. of chromium respectively. See Patent No. 262,206, having the date September 24, 1925.

Iron and Steel

WHEN malleable iron or steel is to be produced in a closed electric furnace a portion only of the theoretical amount of carbonaceous reducing agent necessary to reduce the ore is first added. The remaining reducing agent is then added to the slag in order to reduce the oxide contained therein and to supply the carbon to give the desired carbon content in the finished product. The smelting is carried out by the method described in Specification 262,127. According to the latter patent application, in producing iron or its alloys in the electric furnace the ore, flux, and reducing agent are fed in a thin layer on to the surface of a slag bath and reduced by the heat thereof. The reducing agent, which may be carbonaceous material, ferro-manganese, ferro-silicon, etc., is fed first on to the slag and then followed by the ore which may be pre-heated or partially reduced in a rotary furnace by means of the gases from the electric furnace. Prior to tapping, the furnace may be run warm to reduce any ore remaining and to heat the mass to a temperature suitable for tapping. See Patent Applications 262,126 and 262,127, by E. G. T. Gustafsson, Stockholm, having the International Convention date November 28, 1925.



262,136

According to a patent application by J. Maximoff, M. S. de Costa, and R. P. D. Krebs, Paris, pig iron and steel are freed from impurities and occluded gases by subjecting them to action of centrifugal force while at the temperature of maximum fluidity. Apparatus for carrying out the operation is described, one form consisting of a casing *a* mounted on bearings *c* and provided with a refractory lining *b*; at the bottom is a conduit *h* to which can be applied either a burner *i* or a plug *j*. In use the chamber is rotated, the plug f^1 removed and the charge of molten metal introduced; it passes by the channels *g* to the periphery of the chamber and when refining is complete the speed of rotation is diminished until the impurities flow out at *h*. Finally the refined metal is also removed at *h*. See Patent Application 262,136, having the International Convention date November 28, 1925.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The study of the phenomenon of elastic hysteresis in certain alloys. M. L. Jannin. *Rev. de Metallurgie*, December, 1926, pp. 709–717 (in French).

The production of "tin alloy" from bearing metal scrap (concluded). E. R. Thews. *Continental Met. and Chem. Eng.*, January, pp. 9–11.

The colour of copper-nickel alloys. J. A. M. van Liempt. *Rec. Trav. Chim. Pays-Bas*, January 15, pp. 8–10 (in German).

ANALYSIS.—Rapid determination of silicon in 8 to 17 per cent. ferro-silicon. G. T. Dougherty. *Ind. and Eng. Chem.*, January 1, pp. 165–167.

ANALYSIS, SPECTROGRAPHIC.—Researches on the spectrographic determination of impurities in aluminium and its alloys. R. Adan. *Bull. Féd. Ind. Chem. Belg.*, November, 1926, pp. 447–450 (in French).

CORROSION, ETC.—Electro-deposited coatings for the prevention of corrosion. H. Sutton. *Metal Ind.*, January 21, pp. 87–89, January 28, pp. 111–112.

The effect of oxygen concentration on the corrosion of copper by non-oxidising acids. R. P. Russell and A. White. *Ind. and Eng. Chem.*, January 1, pp. 116–118.

CRYSTALS OF METALS.—The behaviour of aluminium crystals in stretching experiments. F. von Göler, R. Karnop, and G. Sachs. *Naturwissenschaften*, December 24, 1926, pp. 1282–1283 (in German).

GENERAL.—A new blast-furnace process. P. W. Uhlmann. *Chem.-Zeit.*, January 15, pp. 37–38 (in German).

The problem of secondary metals in world affairs. F. W. Willard. *Metal Ind.*, January 14, pp. 61–64.

Contribution to our knowledge of the resistance limits of tungsten-molybdenum mixed crystals. J. A. M. van Liempt. *Rec. Trav. Chim. Pays-Bas*, January 15, 11–17 (in German).

The electrolytic working-up of brass waste in hydrochloric acid solution. W. W. Stender. *Z. anorg. u. allg. Chem.*, December 22, 1926, pp. 145–157.

HARDNESS.—Standardising the Brinell hardness test. H. M. German. *Trans. Amer. Soc. Steel Treating*, January, pp. 54–72.

IRON AND STEEL.—The decomposition of the austenitic structure in steel. R. L. Dowdell and O. E. Harder. *Trans. Amer. Soc. Steel Treating*, January, pp. 17–41.

Volume changes of steel on cold drawing. E. Houdremont and E. Bürklin. *Stahl u. Eisen*, January 20, pp. 90–93 (in German).

The tensile properties of stainless iron and other alloys at elevated temperatures. P. G. McVetty and N. L. Mochel. *Trans. Amer. Soc. Steel Treating*, January, pp. 73–100.

The constitution of steel and cast iron. VI. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*, January, pp. 115–128.

PHASE RULE.—The relation between pseudobinary lines and solid solutions in metallic ternary systems. R. A. Morgen. *J. Amer. Chem. Soc.*, January, pp. 39–43.

On the ternary system copper-zinc-manganese. O. Heusler. *Z. anorg. u. allg. Chem.*, December 22, 1926, pp. 37–54. A complete discussion from the standpoint of the Phase Rule, with notes on the magnetic properties of the products (in German).

The thermal equilibrium from the standpoint of Roozeboom. *Metall u. Erz*, January 1, pp. 1–6. Deals with thermodynamic potential and certain related functions, and their practical application (in German).

SINGLE METALS.—The preparation of metallic cobalt from cobalt-containing metallurgical residues. A. Breinhorst. *Metall u. Erz*, January 1, pp. 7–8 (in German).

Metallic thorium. J. W. Marden and H. C. Reutschler. *Ind. and Eng. Chem.*, January 1, pp. 97–103.

Aluminium and its alloys. H. W. Clarke. *Metal Ind.*, January 7, pp. 21–23.

TOOL STEELS.—Choice and treatment of tool steels. A. Grützner. *Continental Met. and Chem. Eng.*, January, pp. 2–6.

Tool steel failures: Their cause and cure. F. B. Lounsberry. *Trans. Amer. Soc. Steel Treating*, January, pp. 101–114.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

ASKERN COAL AND IRON CO., LTD. Registered December 23, £13,500 (not ex.) mortgage, to building society; charged on properties in Green Lane, Askern. *£640,928. July 19, 1926.

BRITISH GRIFFIN CHILLED IRON AND STEEL CO., LTD. (late BRITISH CHILLED IRON AND STEEL CO., LTD.), Barrow-in-Furness. Registered January 6, £4,000 debentures; general charge (subject to prior debentures). *£7,000. March 3, 1926.

CROGGON AND CO., LTD., London, E.C., iron manufacturers. Registered January 17, £8,000 debenture, to Princes Street Nominees, Ltd., 2, Princes Street, E.C.; general charge. *£13,300. June 30, 1926.

DICKSON (T. W.) (WHITECHAPEL), LTD., founders. Registered December 29, £5,000 debentures; general charge (subject to prior encumbrances); also registered December 29, three Land Registry charges of three mortgages, to Bank; charged on properties at Mile End, etc.

NEW WESTBURY IRON CO., LTD. (Wilts.). Registered January 8, mortgage, to Bank; charged on lands at Dilton Marsh, etc., with mining rights, etc. *£81,000. November 22, 1926.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield. Registered December 29, £1,950 debentures, part of £750,000; general charge (except certain property). *£531,950. October 12, 1925.

Satisfaction

BRITISH GRIFFIN CHILLED IRON AND STEEL CO., LTD. (late BRITISH CHILLED IRON AND STEEL CO., LTD.), Barrow-in-Furness. Satisfaction registered January 6, £1,000, registered September 24, 1925.

Cast Iron Research Association

THE Cast Iron Research Association, in its Bulletin for January, gives a full account of the proceedings at the annual general meeting. In addition, it contains papers on "Cast Iron in 1926," by J. E. Fletcher, and on "Changes in the Specific Electrical Resistance of Cast Iron Due to Heating and Cooling." There is also a note on the analysis of a piece of Swedish cast iron made in 1638, giving the following constituents (percentages): total carbon, 3·80; graphitic carbon, 2·37; combined carbon, 1·43; silicon, 0·50; manganese, 0·05; sulphur, 0·044; and phosphorus, 0·358. The sample had a tensile strength of 10·2 tons per square inch, and a Brinell hardness of 163. It is stated that the research committee proposes shortly to co-operate with Professor D. Hanson at the University of Birmingham in an investigation on the influence of nickel in cast iron.

South African Steel Industry

IT was announced recently in S. Africa that the Government was establishing an iron and steel industry in Pretoria. A company would be floated with a capital of £3,000,000 or £4,000,000, in which the Government would have a controlling interest. Pretoria was the only centre where the industry could be established economically on a large scale, as it had millions of tons of fair grade iron ore on town lands, which they were giving practically gratis to the company. It was declared to be one of the greatest events in South Africa's industrial history, which would do much to relieve unemployment.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Molybdenum in Nickel-Chromium-Medium Carbon Steels

A Report of Recent Work

"The Influence of Molybdenum on Medium Carbon Steels Containing Nickel and Chromium" has been investigated by Mr. J. A. Jones, of the Research Department, Woolwich. The results of the investigation have been published as "R. D. Report No. 67" (H.M. Stationery Office, 3s. 6d.). An account of the work is given below.

MOLYBDENUM as an alloying element in steel has found increasing application during the last few years. References to molybdenum in metallurgical literature are numerous and comprehensive, but it is unnecessary to summarise them, since the recent book *Molybdenum, Cerium and Related Alloy Steels*, by Gillett and Mack, contains a full account of published work with bibliography.

In reviewing the work published by Swinden in this country and by Sargent, McKnight, Schmid, Hunter, Dawe, Mathews, and others in America, Gillett and Mack state:—"There is general agreement among these investigators that the addition of small amounts (0·20 per cent. to 0·75 per cent.) of molybdenum to steel—plain carbon, chromium, nickel or nickel-chromium—makes it possible to obtain, by suitable heat treatment, either higher elastic limit with the same ductility, or at the same elastic limit, higher ductility and especially a higher reduction of area than in steels without it; that they show greater depth-hardening (*i.e.*, more uniform hardness throughout large sections); that they have a wide range of effective hardening temperatures, variation in which does not greatly alter the mechanical properties (*i.e.*, they are not 'sensitive'); and that to secure equivalent softening on tempering with other analogous steels the draw temperatures must be higher. It is also fairly well agreed that the steel machines as well as other steels of the same strength and hardness; that the steel forges well; and that it readily frees itself of scale so that clean forgings result. Several observers, including Mathews, believe that the machining properties are superior to those of other alloy steels. It is at least as free from flaws and other defects as other steels of comparable grades. . . . By choosing a steel of suitable carbon, chromium, and molybdenum content, such a steel can, by suitable variation in heat treatment, be given such a range of properties as to fill a wide range of needs. . . . There appear to be many metallurgical advantages and few drawbacks to the use of molybdenum as an alloying element."

Properties of Molybdenum Steels

As a final result of their own critical examination of the properties of molybdenum steels, Gillett and Mack conclude that "Molybdenum is a very potent alloying element. Even small amounts greatly increase the propensity of steel toward hardening on quenching. This property is increased in the presence of other hardening elements. That is, molybdenum intensifies the hardening effect of other alloying elements. After hardening by quenching, the molybdenum steels require decidedly higher draw temperatures to soften them to the same degree as other similar alloy steels. Heat-treated molybdenum steels of a given strength or hardness can therefore be produced by the choice of a suitable composition of the steel as to molybdenum and other alloying elements in which by a long draw at a high temperature quenching stresses can be largely relieved without softening the steel beyond the required point. The ductility of the molybdenum steels at a given hardness, tensile strength or elastic limit is equal to that of any other and superior to most alloy steels. The great resistance to tempering makes the molybdenum steels attractive for use where strength at high temperatures is desired. When a very high tensile strength at ordinary temperatures is sought, molybdenum again offers a ready and certain means of attaining the result desired. For strengths which can be readily obtained by other heat-treated alloy steels, the use of molybdenum appears to allow as great a latitude in forging and quenching temperatures as is safe with any other alloy steels and greater than is safe with some others."

Previous work carried out in the Research Department, Woolwich, includes comparative tests on material cut from forgings of nickel-chromium-molybdenum steel, and on the same material experimentally treated on the small scale. The effect of molybdenum on susceptibility to temper-brittleness has also been dealt with. In Great Britain the greatest advance in the practical application of molybdenum steel for general engineering and constructional purposes has been due to Messrs. Sir W. G. Armstrong, Whitworth and Co. The success of this firm in the production of large forgings of high yield-point and excellent mechanical properties from steel of which the most marked characteristics are the relative absence of mass effect and non-susceptibility to temper-brittleness should rank as one of the most important metallurgical achievements of recent years.

Tests have been carried out in the Research Department, Woolwich, on material from typical forgings of nickel-chromium-molybdenum steel. The work has now been extended by obtaining small quantities of steel covering a wide range of composition and applying to these steels the experimental treatments and tests described below. Several series of carbon, nickel, chromium, and nickel-chromium steels containing molybdenum up to about 1 per cent. have been investigated. The steels were made by the crucible process, and the ingots were reheated and forged into bars $1\frac{1}{2}$ by $\frac{3}{4}$ in. section.

Thermal Critical Ranges

Heating and cooling curves were taken on a selection of these steels after heating to 900° C. and cooling at about 0·75° C. per minute, the curves being obtained by means of a platinum, platinum-rhodium thermocouple and Carpenter-Stansfield potentiometer used in conjunction with a Rosenhain plotting chronograph. Temperatures were recorded at intervals of 0·01 millivolt, equivalent to about 1° C. The rate of heating employed was about 5° C. per minute below Ac_1. Cooling was begun as soon as the maximum temperature of 900° C. had been reached. The rate of cooling was about 5° C. per minute at 700° C., and diminished with falling temperature to about $2\frac{1}{2}$° C. per minute at 450° C. There was evidence on the heating curves of the beginning of Ac_1 at a temperature of 10° to 20° C. below the maximum. The temperatures given for the Ar_1 points are those of perfectly definite arrests observed under the conditions of cooling stated above. In some cases there were indications of minor arrests at other temperatures, but these points being small and indefinite are not reported.

In nickel-chromium-molybdenum steels it appeared that the Ar point occurred at the upper position (Ar') only, when the rate of cooling was very slow. When the rate of cooling was slightly increased, the point occurred partly at the upper and partly at the lower position. With faster rates of cooling the point was completely depressed to the lower position Ar'' and the steel showed evidence of increased hardness. In taking the thermal curves the rate of cooling necessarily employed was sufficient to depress the Ar point to the lower

position in all the nickel-chromium-molybdenum steels examined. The fact that the position of the critical range was unaffected by considerable variation in rate of cooling and initial temperature indicates that unavoidable variations in the rate of cooling of a forging during treatment are unlikely to have much effect on the critical range. This may explain why mass effect and the influence of initial temperature are less marked in nickel-chromium-molybdenum steels than in similar steels without molybdenum.

Microstructure and Heat Treatment

Small pieces, about 1 in. long and ½ in. square section, were obtained from a selection of the steels for carrying out treatments involving different rates of cooling through the critical range. The rates of cooling from definite initial temperatures were measured, the microstructure of the pieces was then examined, and the Brinell hardness determined. All the steels in the slowly cooled condition were pearlitic. The pearlite varied from lamellar and granular to fine sorbitic, and the ferrite diminished as the molybdenum content increased in each series of steels. With the more rapid rates of cooling the pearlite was mainly sorbitic, while the separation of ferrite was partially suppressed.

The results indicate that all the alloy steels treated as small pieces were fully hardened after quenching in water or oil. The hardening effect of slower rates of cooling differed with different compositions. The presence of molybdenum, however, was particularly beneficial in reducing the liability to imperfect hardening at slower rates of cooling. A considerably slower rate of cooling was sufficient to produce hardening in steels containing about 0·5 per cent. of molybdenum than in similar steels without molybdenum. In carbon steels with upwards of 1·0 per cent. of molybdenum, and in steels containing 4·5 per cent. of nickel and upwards of 0·5 per cent. of molybdenum, the hardness produced with certain rates of cooling was greater the higher the initial temperature, but in nickel-chromium-molybdenum steels there was no evidence that initial temperature had any effect on the critical rate of cooling required to produce hardening. The fall of hardness with increase of tempering temperature was reduced by the presence of molybdenum; 0·5 per cent. of molybdenum was sufficient to produce marked effect, the advantage gained in this respect by increasing the molybdenum to 1·0 per cent. being very slight.

Mechanical Properties

Tensile strength, Brinell hardness, and notched-bar impact tests on samples 1½ by ¾ in. and 5 in. long, heat-treated in the laboratory, were determined. All test pieces were taken in the longitudinal direction. The yield-point was taken as the load giving a permanent extension of 0·2 per cent. (0·004 in. on 2 in.). The notched-bar impact tests were carried out in the 120 ft.-lb. Izod machine on test pieces of the B.E.S.A. standard form, 45° V notch, with a root radius 0·25 millimetre, 2 millimetres deep. In all cases the notches were on the side of the specimen which had originally been nearest the centre of the bar. The treatments consisted of oil-hardening and tempering, with subsequent cooling in air. The microstructures of sections after oil-hardening and tempering at 600° C. and 650° C. were examined. All the steels of low molybdenum content showed structures consisting of ferrite and sorbite; the ferrite did not occur in the form of a network except in the carbon-molybdenum steels. The amount of ferrite decreased as the total amount of alloy elements increased until the steels became entirely sorbitic. Each of the steels examined (other than the carbon-molybdenum steels) gave almost identical results on hardening from 820° C. and 900° C.

The fall of hardness produced in nickel-chromium-molybdenum steels by tempering at 650° C. was less than that shown by nickel, chromium, or nickel-chromium steels, but the further fall of hardness due to prolonging the time of tempering at 650° C. was considerably greater in the nickel-chromium-molybdenum steels than in the same steels without molybdenum.

In tempering it is important not to exceed a certain maximum temperature. In steels cooled rapidly after tempering, hardness is not progressively lowered with rise of tempering temperature. The increase in hardness which may occur on air-cooling, after holding for some time at a temperature considerably below Ac_1, as ordinarily determined, is accompanied by a fall in elastic limit, elongation and impact figure, together with a deterioration in behaviour under the bending test. If slow cooling is adopted after the same tempering treatment the hardening effect is not produced, but the effect on the elastic limit is similar, and it is accompanied by a fall in yield-point. In both cases therefore there is considerable danger that the steel may be rendered unserviceable.

Properties of Various Steels

The addition of 0·6 per cent. of molybdenum to carbon steels resulted in a marked rise of the elastic limit, yield point, maximum load, and notched-bar impact figure, while the elongation remained satisfactory. There were indications of serious segregation in the steel containing 1·23 per cent. of molybdenum, and the results obtained with this steel were irregular.

Although a plain nickel steel was not included in this series, it is evident from results obtained previously on a steel of slightly higher nickel content that the addition of molybdenum to a steel containing 3 per cent. of nickel raises the elastic limit, yield point, maximum load, and impact figure without serious decrease of elongation and reduction of area. This improvement in properties was very marked with the addition of 0·6 per cent. of molybdenum, but, except for very high tensile strength, little further improvement resulted from additions of molybdenum above this amount. A steel containing 4·5 per cent. of nickel with 0·5 per cent. of molybdenum is only suitable when high tensile strength (over 55 tons per sq. in.) is required, and there appears to be no advantage in exceeding 0·5 per cent. of molybdenum. A steel with 3 per cent. of nickel and 1 per cent. of molybdenum was found to be similar in properties to one containing 4·5 per cent. of nickel and 0·5 per cent. of molybdenum when tempered to the same hardness, but the steel with the higher molybdenum content required a higher tempering temperature and had a slightly better impact figure.

Marked improvement in the properties of steels containing approximately 1·0, 1·5 and 2·0 per cent. respectively of chromium resulted from the addition of 0·5 per cent. of molybdenum. In the case of the 1·0 per cent. chromium steel the properties were further improved by the addition of molybdenum up to 1·0 per cent., but no advantage was gained by increasing the molybdenum content beyond this amount. The results also illustrate the influence of chromium on a steel containing 0·5 per cent. of molybdenum. Great improvement of properties was effected by the addition of 1 per cent. of chromium, and this continued with additions of chromium up to 1·5 per cent., but no advantage was gained by further increasing the chromium except for steels of high tensile strength (over 60 tons per sq. in.).

Additions of molybdenum to nickel-chromium steels always gave improved properties, but the percentage of molybdenum beyond which no further advantage was gained varied with the nickel and chromium content, decreasing from about 0·8 for the steels of lowest total nickel and chromium contents to about 0·35 for steels with the highest chromium and nickel contents examined.

In nickel-chromium-molybdenum steels containing:

Carbon, per cent.	Nickel, per cent.	Chromium, per cent.	Molybdenum, per cent.
0·26	2·57	0·67	0·62

variations in manganese content between 0·33 and 0·64 per cent. had no effect on the general mechanical properties of the steels tempered between 600° C. and 670° C. (tensile strength between 66 and 50 tons per sq. in.). There were, however, indications that in steels treated to the same Brinell hardness those in which the manganese content was below 0·33 per cent. showed slightly higher elongation and impact figure. The effect of high manganese content in increasing the susceptibility of steel to temper-brittleness was rendered negligibly small by the presence of molybdenum.

Summary and Conclusions

The thermal critical ranges, microstructure, and mechanical properties of a number of nickel, chromium, and nickel-chromium steels containing molybdenum have been investigated. The steels covered the following range of composition:—

Type.	Carbon, per cent.	Nickel, per cent.	Chromium, per cent.	Molybdenum, per cent.
C-Mo	0·26 to 0·30	Nil	Nil	0 to 1·2
Ni-Mo ...	0·26 to 0·30	0 to 4·6	Nil	0 to 1·0
Cr-Mo.....	0·25 to 0·33	Nil	0 to 2·0	0 to 1·4
Ni-Cr-Mo .	0·22 to 0·37	1·7 to 3·7	0·5 to 1·2	0 to 1·1

Increasing molybdenum content slightly raises Ac_1 and lowers Ar_1, but its quantitative effect on the Ar_1 point varies considerably in different steels. In all the steels examined containing more than 1 per cent. of molybdenum, and in steels containing upwards of 0·3 per cent. molybdenum with over 2 per cent. of nickel plus chromium, the Ar point was partially or entirely depressed to the Ar'' position at the rate of cooling employed in taking the curves (5° C. per minute at 700° C.). By means of the dilatometer it was found that in a steel containing carbon 0·29, nickel 2·47, chromium 0·64, and molybdenum 0·47 per cent. the Ar point, which normally occurred entirely at the Ar'' position (470° C.), was completed in the Ar^1 position (650° C.) when the rate of cooling was 0·5° C. per minute. Initial temperature is without effect on the position of the Ar'' point.

Molybdenum has a more powerful effect than nickel or chromium in reducing liability to imperfect hardening when the rate of cooling is slow. It also reduces the softening effect of tempering. Although these changes in the characteristic properties of a steel due to the presence of molybdenum are progressive, with increase of molybdenum content the most marked effect is produced in nickel-chromium steels by the addition of not more than 0·5 per cent. molybdenum, the further advantage gained by adding more molybdenum being comparatively slight. The same property of complete hardening with moderate rates of cooling is revealed in the relative absence of mass effect in the nickel-chromium-molybdenum steels as compared with the nickel-chromium steels, shown by the uniformity of properties throughout the walls of large forgings after treatment. This property makes it more justifiable in the case of nickel-chromium-molybdenum steels than in most other alloy steels to make direct use of the results of treatment on a small scale to forecast properties of large forgings after treatment. It was found that results obtained by heat treatment of all the alloy steels containing molybdenum could be repeated with great regularity, showing that the steels were unaffected by slight departure from standard conditions of treatment.

Nickel-chromium-molybdenum steels provide the best all-round combination of properties, but they are closely approached by certain nickel-molybdenum and chromium-molybdenum steels, each of which types shows some advantages and some disadvantages. For example, the chromium-molybdenum steels are distinguished by a high notched-bar impact figure, though the elastic limit and yield point are slightly lower than those of nickel-chromium-molybdenum steels of the same hardness. Nickel-molybdenum steels, on the other hand, show higher yield ratios with considerably lower impact figures than nickel-chromium-molybdenum steels. Moreover, they are more difficult to machine when the nickel content exceeds 3 per cent., which it must do to enable a tensile strength of 60 tons per sq. in. to be obtained, and tests made after different rates of cooling indicate that they are more susceptible to mass effect than the nickel-chromium-molybdenum steels. The results of tests given in this report enable a choice of the most promising compositions to be made for material intended to give a tensile strength of 50 to 60 tons per square inch. The compositions of each type giving the best combination of mechanical properties in this range of hardness were as follows :—

Type.	Composition. Carbon, per cent.	Nickel, per cent.	Chromium, per cent.	Molybdenum, per cent.	Remarks.
Nickel-chromium-molybdenum	0·3	2·6	0·6 to 1·1	0·6 to 0·4	This range of composition gave very similar properties when tempered to the same hardness, the higher chromium being an advantage when a tensile strength of 60 tons or over is required.
Chromium-molybdenum	0·3	—	1·0 to 1·5	1·0 to 0·5	Slightly inferior in general properties to the above, but superior in notched-bar impact figure.
Nickel-molybdenum	0·3	2·7 to 4·0	—	0·6 to 0·4	Rather better in yield ratio than the nickel-chromium - molybdenum steel above, but inferior in impact figure. When nickel exceeds 3 per cent. these steels show distinctly lower impact figures; also machining becomes difficult.

Electrodeposition of Iron

Paper before Electroplaters' Society

At a meeting of the Electroplaters' and Depositors' Technical Society, held on Wednesday, February 23, at the Northampton Polytechnic Institute, a paper on the "Electrodeposition of Iron" was read by Mr. T. Johnston. The chair was taken by Mr. D. J. MacNaughtan.

Mr. Johnston exhibited a comprehensive range of electrolytic iron in the various stages of manufacture of iron articles, such as cores, etc., used in electrical engineering, "built up" engineering parts, and examples of deposits obtained in works practice. He prefaced his paper with a *résumé* of the history of iron deposition, and showed that progressive improvements had brought up the employable current density from 2 to as high as 240 amps/ft². There were many difficulties met with in the process, owing to the chemical and electrochemical peculiarities of iron. The depositing solutions commonly used were based on the simple sulphate and chloride solutions, or mixture of these, three characteristic baths being the Fischer-Langbein (chloride) solution, the Burgess-Hambuechen (sulphate) solution and the Watts-Li (sulphate-chloride) solution. In all cases it was best to use fairly high temperatures, and comparatively high current densities could be employed. Iron baths were very sensitive to slight variation in conditions, one of the most important factors being the degree of acidity of the bath.

The purity of electrolytic iron might reach 99·96 to 99·99 per cent. Hydrogen, which was occluded in large quantities, was difficult to eliminate, but it was possible to effect this by suitable heat treatment. The metal was then highly ductile and particularly suitable for cold working, stamping, etc. Among the most interesting applications were the following :—The "steel-facing" of printing blocks; "building up" worn and undersized parts; production of finely divided magnetic material; manufacture of tubes, sheets and strip; and preparation of "pure" iron for research, etc.

Discussion

In the subsequent discussion, Mr. E. A. Ollard stated that iron in being used for filling up blow-holes, etc., had an advantage over nickel for this purpose in regard to the colour of the metal. He described the "jet" process and added that the adhesion of the iron on steel and cast iron was good. The use of sulphur dioxide had been advocated to effect reduction of ferric salts. Mr. Lovelock said that he used a cold solution for "building up," as wax was used as a stopper, and a saturated solution of ferrous ammonium sulphate at a p_H of 5·5. A bath was built round the part and a thickness one-sixteenth of an inch could be deposited satisfactorily. Iron was preferred to nickel not only on account of colour but because it machined well.

In regard to p_H determinations Mr. A. W. Hothersall said that they could be made colorimetrically on filtered samples, though chloride solutions were apt to cloud. There was so little colour that rapid determinations could also be made with the capillator. Another advantage that iron possessed over nickel was that it could be case-hardened, and heat treatment generally improved the properties of the deposit. Mr. S. Wernick said that the deposition of iron was different from the plating of most common metals owing to the instability of the baths due to oxidation. For the same reason, it had been found difficult to assign a definite value for the equilibrium potential of iron. It was not clear how the calcium chloride in the ferrous chloride-calcium chloride baths functioned, since common salt had been substituted with good results. Having regard to the importance of acidity, it was surprising that a buffer was not used. Probably the bath would become more stable as means to maintain a correct p_H were evolved.

The meeting concluded with a vote of thanks to the author of the paper, copies of which may be obtained from the hon. secretary, Mr. W. E. Harris, 193, Eversleigh Road, Battersea, London, S.W.11. The next meeting of the Society takes place on March 16, when a discussion on the "Electrodeposition of Alloys" will be opened by Mr. S. Field, the president of the Society.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Manganese Developments

HITHERTO the uses of manganese, as a metal, have been somewhat restricted, although they have, none the less, been of vital importance to the steel industry, which could hardly, indeed, exist without the metal. In the brass foundry it is as useful as a deoxidiser as it is in the steel ladle, where it performs the further indispensable function of either eliminating sulphur, or rendering it comparatively innocuous, or both. It hardens bronze and is used in aluminium alloys, but its employment in non-ferrous metallurgy is limited. Alloyed with iron, it yields manganese steel, one of the most valuable of the ferrous alloys, for which the world is indebted to Sir Robert Hadfield. Hitherto the supplies of manganese, although widely distributed and abundant, have been barely more than adequate to meet the very large demand of the steel trade, and it will be recalled that, during the war, Germany was greatly handicapped in this respect by lack of manganese, and had to have recourse to the using up of old manganiferous slags. In America, of late, serious apprehensions have been voiced of a world shortage of manganese. Such apprehensions are, it would appear, baseless. There is, according to tradition, always something new out of Africa, and this tradition has once again been verified by the discovery of the enormous manganese ore deposits of Postmasburg. Estimated at a thousand million tons of high grade ore varying in content from 42 to 58 per cent. of manganese, these deposits will ensure adequate supplies for many years to come, and it is possible that fresh applications of the metal will be discovered. The preoccupations of the steel industry being relieved, ferro-manganese should become cheaper, and pure manganese something more than the chemical curiosity it still appears to be.

Influence in Nickel Plating

IN some connections, however, manganese has a bad reputation, whether deservedly so or not. It has been charged, *inter alia*, with increasing the rate of corrosion in steel, a very heinous charge which has not, however, been incontestably proved against it. The latest charge laid to its account is one of obnoxious behaviour in nickel plating. Mr. W. R. Barclay stressed the necessity of having anodes of the very purest quality when electroplating operations with nickel are in hand. The occasion was the reading of a paper on nickel coatings, before the London Section of the Institute of Metals. It was formerly the practice to add manganese to nickel when casting anodes, although the literature of the subject is discreetly silent as to this practice and the why and the wherefore of it. It now seems that the practice was altogether wrong, and not only Mr. Barclay, but several of the speakers in the subsequent discussion, emphasised the extreme undesirability of the contamination of nickel anodes by manganese. Further information on this interesting point was promised by one of the speakers, and will be looked forward to by students of corrosion as well as by those concerned in electroplating operations.

Metallurgy in Ancient Egypt

THE trouble about Egyptology is that so far as the earliest dynasties are concerned Egyptologists are by no means agreed as to the system of chronology to be adopted. One school places the advent of the first dynasty some 1,500 years earlier than another school. Hitherto no decisive criterion has been discovered. The late Major H. Garland takes, in his interesting little work published posthumously, the more conservative estimate. Hence the earliest metal objects, amongst which are the iron tool found in the Great Pyramid, date back to 2900 B.C., which makes them only some 4,800 years old, instead of some 6,300 years old, if the Maspéro system of dating be employed. From this positive evidence; from a mass of very reasonable negative evidence, and from certain assumptions Major Garland argues that the use of iron in Egypt began far earlier than many eminent authorities seem disposed to admit. The working of adamantine stone, such as the diorite and granite favoured by very ancient sculptors, has always been a stumbling-block to metallurgists, who have inclined to a theory that the ancient Egyptians were acquainted with secrets of hardening bronze, which have never been rediscovered. Of that theory, it must be confessed, Major Garland effectively disposes.

Ancient Foundry Processes

HE has much of interest to tell his readers of ancient Egyptian methods of foundry work. He believes them to have invented the *cire-perdu* process in the casting of small copper and bronze articles. He was for some years Superintendent of the laboratories at the Citadel, Cairo, and his interest in the ancient methods employed in metallurgy are focused a bit too exclusively on the Egyptian antiquities within his own ken. He does less than justice, it may be thought, to the metallurgists of other dim and shadowy northern and eastern peoples who preceded the Egyptians of even the first dynasty. There is more than mere legend in the repeated statements of ancient writers that the cradle of iron metallurgy was further north or north-east. Nor does Chaldea get fair credit for its contributions. In any case, however, the micrographic section of Major Garland's little book is a welcome chapter, which throws an interesting light on both the achievements and the shortcomings of ancient workers, and will do much to discount some of the hypotheses as to their hidden lore and lost secrets.

Theories of Cementation

TO the careful and extensive investigations into the mode whereby carbon enters into and combines with iron, during processes of case-hardening and cementation, carried out some years ago by Gioletti, A. Bramley, in collaboration with A. J. Jinkins and G. H. Beeby, has added a fresh, equally careful and extensive series of experiments. They are described in the latest issue of Carnegie Scholarship Memoirs. Gioletti came to the conclusion that at temperatures above 800° C. solid carbon was capable of cementing iron, without the intervention of gaseous carbonaceous substances, a conclusion which would seem to be borne out by the ordinary practice in regard to making blister bars. Bramley does not consider this conclusion warranted. It was, moreover, in opposition to the view expressed by a number of other investigators, including Guillet, Charpy, and Bonnerot. That view was that no cementation could take place in a vacuum, unless the carbonaceous substances were in very close contact, under pressure, with the iron. "The direct action of solid carbon—if it acts at all—is extremely small, and gaseous substances are the active agents in the carburisation of iron, as ordinarily carried out." How this conclusion can be justified by the experimental results now published, is not clear, seeing that Bramley's experiments were all conducted with gaseous carbon compounds, and by no means necessarily exclude the positive evidence that solid carbonaceous bodies do, in practice, convey carbon to iron.

Negative Evidence Not Conclusive

ACADEMIC papers of this nature are apt to over-emphasise the inferences to be drawn from carefully controlled experiments, and to ignore actual practical results. Thus, to obtain uniformity of results in gaseous carburisation it is necessary, we are told, to reverse periodically the direction of the flow of the gas; to support the bar to be cemented in such a way as to allow the gas to circulate freely around the specimen; and "to thoroughly dry the carburising gas." The two former precautions appear to have been "entirely neglected by previous workers," and in the past, the third named condition has "probably not received the attention it merits." All this is somewhat didactical. It can only carry weight in the presence of evidence that uniform carburisation has never been achieved by any other means than those described. It ignores day to day practice in which very uniform diffusion of carbon is, *de facto*, secured, in case-hardening operations, in the entire absence of the conditions laid down as essential. This is not to say that Bramley's work is not both interesting and instructive; but merely that some of the conclusions are of too generalised a nature.

Efficiency of Cyanide Compounds

WHAT is of most interest in these very well contrived and carefully conducted experiments, is the relative carburising efficiency of pyridine and methyl cyanide. The former is

less efficient than the latter at temperatures above 1,000° C. Methyl cyanide caused an increase in the carbon concentration accompanied by a decrease in the nitrogen concentration in the cemented zone. Pyridine, on the other hand, caused both the carbon and the nitrogen to increase to a maximum and to fall again, in proportion as either the period or temperature of cementation was increased. This is a practical result for which uses can be found in industry. Meanwhile the cyanide compounds, and such humble solid substances as horn and leather, which yield cyanide compounds, will still continue to be used by the smith and the case-hardener, oblivious of theories of the function of gaseous compounds. The smith, in particular, will continue to rub his chisels with cyanides or ferrocyanides and get astonishingly good results, and as high a degree of uniform penetration and diffusion of the carbon as will best serve his purpose. At the same time another practical and suggestive prospect is opened out by Mr. Bramley's experiments on Armco iron. Pure iron of that kind would appear to be very specially suitable for and amenable to cementation and case-hardening. There is no intrinsic reason, indeed, why it should not be used as a material for the ultimate production of the very highest grades of crucible steel.

Evans' "Corrosion of Metals"

In view of the attention which is being paid to the subject at the moment, the appearance of the second edition of *The Corrosion of Metals*, by Ulick R. Evans (London: Edward Arnold and Co., pp. 259, 15s.), is very timely. Mr. Evans is opposed to the view that corrosion is a more or less capricious phenomenon, in which every case is to be considered as a law unto itself; on the contrary, he is of the opinion that the subject must be regarded as a whole from the standpoint of a few simple principles, recent research having shown, as he says, "that it is quite possible to explain why corrosion is set up at certain places, and not at others." A proper comprehension of the subject involves a knowledge of electrochemistry, and this is therefore treated in an early chapter. The author then proceeds to discuss anodic corrosion by means of an externally applied current, corrosion involving the production of hydrogen gas, corrosion involving the presence of dissolved oxygen, passivity and other effects produced by oxidising agents, corrosion of copper and copper alloys, corrosion and tarnishing in a moist and polluted atmosphere, and factors involving the velocity of corrosion.

The last two chapters deal with means of avoiding corrosion. One of these chapters discusses protective measures. These may be divided into two classes, that is, methods based on preliminary treatment of the water which is causing the trouble, and methods of coating the metal with a protective layer. The first method depends on removal of oxygen from the water or the treatment of the water with chemicals. The second method—application of a protective layer—may be effected in a variety of ways; by using a layer of another, more resistant, metal (which may be applied by dipping in a bath of a molten metal, by electrical coating, by heating in a metallic dust—the "sherardising" process for obtaining a coat of zinc or iron, and the "calorising" and "chromising" processes—by the metal spraying process of Schoop, and by mechanical application); by using a layer of paint, enamel, or varnish; or a layer of tarry or bituminous composition; or a layer of cement or concrete; or a layer of glassy enamel; or a thin film of oxide, phosphate, etc., produced by suitable treatment of the article after manufacture; or a layer of grease or oil. The last chapter of the book gives a comprehensive account of corrosion-resisting metals and alloys, among which are discussed chromium steels, chromium-nickel steels, alloys of cobalt, nickel-copper alloys, and alloys containing aluminium, silicon, or lead. There is a useful appendix containing a summary, for reference purposes, of the behaviour of individual metals to different corrosive agencies, the metals being grouped according to the periodic classification. Apart from the value of Mr. Evans' book as a general treatise, any chemist or engineer who is troubled by corrosion effects will find it a useful member of his laboratory bookshelf.

Wrought Magnesium and Magnesium Alloys

Report No. 1037 of the Engineering Research Board of the Department of Scientific and Industrial Research, by S. L. Archbutt and J. W. Jenkin, deals with magnesium and magnesium alloys. The use of this metal and its alloys is of considerable importance where the saving of weight is a first consideration, as this metal is much lighter than aluminium. Cast magnesium alloys have already been used in aeroplane engines, and the present work commences a research to fill the gap in the knowledge of the wrought alloys. The materials chosen are the metal itself, its alloys with 3 and 13 per cent. of copper, with 6 per cent. of aluminium and the proprietary alloy "electron," the composition of which is given as: zinc 4·38 per cent., silicon and aluminium 0·15 per cent. each, and copper 0·22 per cent., the remainder being magnesium. The melting and rolling of the alloys are described in detail, and typical values of the mechanical properties of 1 in. hot-rolled rod at atmospheric temperatures are given. The effect of prolonged heating to 350° C. has been determined for magnesium and its alloy with 6 per cent. of aluminium. There is a decrease in both the maximum stress and the elongation. The impact test, however, shows that no embrittling accompanies this loss of elongation, the energy absorbed actually increasing very markedly in the case of the alloy. The Brinell hardness of all the materials has been determined at temperatures up to 350° C. and complicated changes are observed.

Effect of Liquids on Metal Fatigue

A few workers have already carried out experiments on the fatigue of metals in the presence of chemicals, including Haigh, J. A. Jones, G. Slater, and S. C. Langdon. Other papers on the subject have been published in *Stahl und Eisen* and the *Journal of the Institute of Metals*. Under the title "The Variation in the Fatigue Strength of Metals Tested in the Presence of Different Liquids" (H. M. Stationery Office, 1s. To be published shortly), Mr. G. D. Lehmann describes researches carried out in the Engineering Laboratories at Oxford, following a suggestion by the Elasticity and Fatigue Sub-Committee of the Aeronautical Research Committee. The most unusual result was the increase of the fatigue limit by 6 per cent. when the steel was tested in the presence of sodium chloride. Wöhler fatigue tests were made on specimens of both the Aeronautical Research Committee standard steels in the presence of hot aqueous solutions of sodium nitrate, sodium chloride, and ammonium chloride; also in water after the steel had been pickled in sulphuric acid; also in oil. Control tests were made in hot water and in air at atmospheric temperature. The results showed that oil had no effect; pickling reduced the fatigue strength about 8 per cent. Ammonium chloride reduced the fatigue strength 16 per cent. Sodium chloride *raised* the fatigue limit 6 per cent. Sodium nitrate produced no effect on the 0·33 per cent. carbon steel, but lowered the fatigue limit of the 0·13 per cent. carbon steel by 4 per cent.

The British Metal Corporation

The report of the directors of the British Metal Corporation, Ltd., to be submitted to the shareholders at the ordinary annual general meeting on March 9, has been issued. The audited statement of accounts for the year ended December 31, 1926, shows the profit for the year, after payment of all expenses and appropriating £50,000 to reserve account, to be £81,791, which with £19,966 brought forward from last year, gives a total of £101,757. The directors recommend a dividend of 8 per cent. upon the paid-up capital in its old form as at December 8, 1926 (payable less income tax), requiring £78,480, which leaves to be carried forward £23,277. The changes in the capital of the corporation, as authorised at the extraordinary general meetings held in December, 1926, have been duly carried out, although they are only partially shown in the present balance sheet. The metal trade in the United Kingdom for the past year was seriously affected by the coal strike, but owing to the wide range of the Corporation's activities its profits have been maintained. The directors regret to record the death, in October last, of their colleague, Mr. F. A. Govett. To fill the vacancy thus created, Mr. W. S Robinson has been elected to the board. In accordance with the articles of association he retires, but, being eligible, offers himself for re-election. Sir Charles W. Fielding and Captain O. Lyttelton, directors, retire by rotation, but, being eligible, offer themselves for re-election. The auditors, Deloitte, Plender, Griffiths and Co., offer themselves for reappointment.

Trade, Commerce, Finance : The Month in Review

From Our Northern Correspondent

It is difficult to give a really accurate impression of the state of the iron and steel trade of the country to-day. Of course everyone knows that the steel works are very busy, but what one desires is a correct estimate of the condition of the industry ; and frankly when all the evidence is studied the result is not too hopeful.

Excessive Optimism ?

In saying this, it is not forgotten that many optimistic statements have appeared in the newspapers recently about the signs of improvement in industry, evidences of prosperity in this trade and that ; and the exceptional activity in the steel works lends colour to the general impression. Sir W. Larke, the director of the National Federation of Iron and Steel Manufacturers, was reported as having drawn comfort from the fact that there are now more blast furnaces in operation than before the stoppage. That may be so, but it is not too good ground to build upon. It can, indeed, be said that the steel works are busier now than they have been for some years, that every plant is running almost to full capacity, and that production is being maintained at a very high rate. But what of that ? If the facts are analysed it will be seen that the situation is quite abnormal, and that instead of taking it as evidence of a revival in this particular industry, it would be wiser to look ahead and prepare for the reaction which, unfortunately, seems certain to come within a comparatively short time.

Supply Overtaking Demand

It has been pointed out previously that the unusual activity of the works at present is due to the large accumulation of orders from the stoppage caused by the coal strike. The amount of steel produced in this country during the stoppage was negligible. A fairly large quantity was imported from abroad, but the excess over the normal imports was only a small portion of the country's requirements. To the orders on the books at the end of April there were added fresh orders daily throughout the strike until, on the resumption of work, the weight of orders in every steel works was sufficient to enable the mills to operate at full speed. There were two good reasons for getting the maximum output :—first, the reduction in the cost of production which would be ensured thereby ; and secondly, the clamour for deliveries of steel from customers who had been held up for want of supplies. The cry everywhere was for immediate deliveries and steel could not be made fast enough.

To some extent that position still holds good and the supply is still far behind the demand. But we are rapidly approaching the time when, excepting certain special lines, the supply will have not only overtaken the demand but far exceeded it, and then, unless something happens in the meantime to prevent it, we shall be back again in the old rut of price-cutting and scrambling for orders.

New Business Wanted

The trouble is that the amount of new business coming forward is very much less than the weight of steel being sent out each week. There was some hope that the falling off might be only temporary, but it is continuing, and in a few weeks the arrears will have been practically cleared off, and there will be only the current requirements to meet. Every steel maker has the same story to tell. It must also be borne in mind that for quite a large proportion of the work that is being turned out, the steel maker is getting only the prices which were fixed before the strike, while he has to pay the increased cost of coal and coke, and in many cases the increased railway rates. The total of these additions to the cost of manufacture will far outweigh the reductions which may be obtained by large outputs ; consequently so far as the ordinary trade is concerned, the steel maker has no chance of recouping himself for the losses caused by the strike, or of providing for the time, not far ahead, when partial operation will be the only possibility.

Price-cutting Returning

It is never pleasant to write in a pessimistic strain, and even now there is always at the back of one's mind the hope that after all some of the alluring prophesies made by those who should be in a position to know will be realised, but so far the actual evidence is against such a realisation. Many of the works are already promising comparatively quick delivery of new orders, and evidently the promises are being kept. This fact and the trend of prices show that the makers are beginning to get rather anxious about the order books. Many of the prices quoted in the papers are merely nominal and indeed are often misleading. It is almost impossible to obtain the prices which are reported as being the market prices for certain kinds of steel. As a matter of fact, price-cutting is becoming more and more noticeable.

It is a general impression that the second half of the year will see still lower prices, and in support of this belief there is little hesitation in shading prices quoted for forward contracts. Certainly the buyers are convinced that prices will come down, and even if they have business to place, they are holding it back as long as possible, expecting to see their views confirmed.

Other Side of the Picture

If we look at the other side of the picture it may be possible to find some comfort in the thought that the present absence of buying may be caused by so many consumers being fully occupied with the materials which they are getting in against old orders and waiting to see how things move before making new contracts ; also from the fact that there have recently been some good orders placed with the engineering and shipbuilding firms which will mean more orders for the steel works. No doubt those who are predicting good times for the iron and steel trade have these things in mind, but one would like to see not such a wide gap between the output of steel and the weight of orders received each week.

Fuel Supplies

The position in regard to fuel supplies for the works is still unsettled. Coal is rather more plentiful and the smaller works which at the beginning of the year were able to hold off contracting and buy from hand to mouth are now finding that the price is somewhat easier. On the other hand coke is as short as ever and the price is harder. Every blast furnace owner is suffering from the shortage of supplies, and it seems hopeless to get this state of things remedied just now. The trouble is that practically every coke maker has contracted for more than he can produce, and therefore outputs are being rationed with the result that no one is getting his full share. The wagon shortage is still acute and contributes to the difficulty. This scarcity and dearness combined are a very serious handicap to the pig iron makers, and are largely a contributory cause to the lack of confidence which seems to characterise the markets. Pig iron users are wanting to see the price at the pre-strike level, which of course is quite out of the question until fuel prices alter. Naturally in such conditions the pig iron market is not very bright.

Continental Cartel

The Continental Cartel is not working too smoothly. The German makers are complaining that their quota is not sufficient, and on the first ascertainment they are due to pay a considerable sum in fines for excess production, while on the other hand France draws a somewhat smaller amount as compensation. Another complaint is that the Cartel has not been able to keep up prices. Meanwhile the question of joining the Cartel is still being considered by the British makers, but there is no hurry about it and it is more likely than not that there will soon be no Cartel to join, or that the proposal will be definitely turned down.

The output figures for January show the return to full activity, as far as steel is concerned, although pig iron is not yet fully recovered. The output of pig iron was 434,600 tons, compared with 533,500 tons in January, 1926. There were 152 furnaces in blast at the end of the month, which is five more than before the stoppage. The production of steel amounted to 730,700 tons compared with 640,400 tons in January, 1926. The imports of iron and steel for the month were 555,500 tons, which is the highest figure yet recorded. No doubt this is due to the contracts placed abroad during the strike, which had not been completed.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Recovering Precious Metals

IF the slimes recovered in the electrolytic refining of copper are roasted directly for removal of metalloid impurities (tellurium, arsenic, and antimony) it often happens that the whole fuses to a "matte" before the impurities have been volatilised. According to a patent by N. Baraboshkin and "Trust Uralkupfer," Swerdlowsk, Russia, this is due to the presence of an excessive amount of copper in the slimes. The latter are accordingly first freed from copper by any known method, such as by means of sulphuric acid, and can then be roasted for elimination of metalloids and finally fused with addition of a flux for the isolation of the precious metals. See Patent No. 263,642, having the date January 26, 1926.

Welding Aluminium, etc.

THE fluxes, consisting of alkali halides, used for welding aluminium, magnesium, and other metal alloys are frequently hygroscopic, and when damp are not so successful. According to a patent by J. R. Booer, W. R. J. Britten, and the District Chemical Co., Ltd., London, such fluxes contain the ingredients in molecular proportions or multiples of molecular proportions. They can then be fused and ground to powders which are uniform in composition and without hygroscopic properties. Activating agents, such as alkali fluorides, which accelerate the elimination of the oxide of the metal to be welded, may also be present. Examples are given of mixtures containing barium, potassium, sodium, and lithium chlorides, and potassium fluoride. See Patent No. 264,238, having the date October 15, 1925.

Ferro-chrome Alloys

T. D. KELLY, of London, describes a ferro-chrome alloy which when cast is malleable and can be worked cold like ordinary iron. It contains 10–35 per cent. of chromium, and 7–25 per cent. of copper or nickel-copper, the remainder being iron; the ingredients are melted under a flux of magnesium or calcium chloride and carbon. See Patent No. 264,414, having the date September 4, 1926.

Lead and Silver

IN Specification 250,991 (see THE CHEMICAL AGE, Vol. XV, Met. Section, page 7) is described a process for concentrating copper ores according to which the ore is heated in the presence of a carbonaceous reducing agent and a halogen, whereby the metal is caused to come out of the ore particles in a reduced condition. A similar process is now applied to silver- and lead-containing ores. The halogen can be supplied in the form of an alkali or alkaline earth chloride. If, however, the ore contains an alkaline earth compound such as calcite, alkali may be produced during the heat treatment; this may be avoided by using as the source of the halogen a metal chloride which does not give rise to alkali, for example, manganese, iron, or copper chlorides; should the calcite be present in very large quantities it is advantageous to convert it into calcium sulphide by adding to the ore to be roasted a metallic sulphide such as pyrites or chalcopyrite. The metal values can be removed from the gangue either by leaching or by a physical concentration process. Examples are given illustrating the treatment of a copper ore containing silver, and a Siberian oxidised lead ore. See Patent No. 264,584, by E. Edser, B. Taplin, and Metal Productions, Ltd., London, having the date October 21, 1925.

It is known that although galena is more or less completely decomposed by cold hydrochloric acid, the lead in complex sulphide ores cannot be thus completely converted into lead chloride. According to S. C. Smith, London, such ores can be satisfactorily decomposed in the cold if the acid is sufficiently concentrated. The lead chloride so produced can then be extracted by means of solvents such as brine in the known manner, other metallic sulphides remaining in the residue. In order to work the process economically the ore is preferably treated in counter-current with hydrochloric acid of continuously increasing strength. It is sometimes advantageous first to heat the ore to dull red heat to render some of the constituents less sensitive to attack by the acid. The treatment with acid may also be interrupted at intervals and the lead chloride formed removed by leaching. The weak acid used in the early stages may contain some sulphuric acid, which is preferentially consumed in attacking the more readily soluble parts of the ore; alternatively the ore may be subjected to a preliminary treatment with sulphuric acid. When the ore contains metals such as calcium, iron, or magnesium, which yield soluble chlorides, it may first be partially converted, by roasting, into lead sulphate; the latter then yields lead chloride by double decomposition with the calcium, etc., chlorides. The spent liquor is a good solvent for silver, but poor for lead chloride, and may be used therefore for extracting silver from the chloridised ore. Details of the treatment of a number of lead-zinc sulphide ores are given. See Patent No. 264,569, having the date July 21, 1925.

Alloys

ACCORDING to a Patent Application by the I.G. Farbenindustrie Akt.-Ges., Germany, magnesium alloys suitable for pistons of internal combustion engines can be hardened by an addition of up to 32 per cent. of cerium or cerium metals. See Patent Application 263,755, having the International Convention date December 24, 1925.

According to W. B. Penniman and E. J. Shackleton, of Baltimore, U.S.A., ferro-chrome alloys are decarburised by treatment in an electric furnace with chrome ore beneath a slag which may consist of lime and fluorspar. The product is then deoxidised in the usual manner by means of ferro-silicon or ferro-silicon-aluminium. See Patent Application No. 262,795, having the International Convention date December 11, 1925.

An addition of one or more of the metals chromium, nickel, tungsten, and molybdenum confers increased hardness upon manganese steels containing 10 to 15 per cent. of the latter metal and up to 1 per cent. of carbon. See Patent Application No. 263,811 (Kohlswa Jernwerks Aktiebolag, Kolsva, Sweden), having the International Convention date December 23, 1925.

Froth Flotation Processes

IT is known that in the froth-flotation treatment of minerals containing galena and blende an addition of a metallic salt of an alkyl derivative of a sulpho-thiocarbonic acid enhances the flotability of both these substances, particularly the former. According to a Patent by Minerals Separation, Ltd., and L. A. Wood, London, if the frothing agent employed is such that it is entirely soluble in the circuit liquor and the alkyl-sulphothiocarbonic acid salt (for instance, an alkali xanthate) is added in limited quantity, it is possible by a preliminary operation to float off the galena; a small addition of an alkali cyanide is also beneficial. The residual pulp is then further subjected to flotation after rendering just alkaline and adding copper sulphate or similar cyanicide; the blende is thus also floated off. Examples are given illustrating the separation of galena and blende from (1) a complex Siberian ore containing galena, blende, chalcopyrite, pyrrhotite, and pyrites, and (2) a lead-zinc ore from British Columbia. The method is also applicable to the separation of blende from, say, a zinc-iron ore. See Patent No. 262,492, having the date August 12, 1925.

Electrolytic Processes

H. S. MACKAY, London, describes a modified electrolytic method for the production of copper and zinc from ores containing them. The roasted ore is leached as usual with sulphuric acid, and the acid solution electrolysed for separation of copper until the liquid contains relatively little copper as compared with zinc. The solution is then concentrated considerably and much of the zinc separated as sulphate by crystallisation. The mother liquors are returned to the electrolytic cells for further electrolysis and evaporation. The zinc sulphate is freed from traces of copper by solution in water and treating with either zinc dust or calcium carbonate; the residues produced when zinc dust is used are returned to the roasting furnaces, and the copper hydrate produced when calcium carbonate is employed is used for removing iron and aluminium from the leaching liquor. The purified zinc sulphate solution is either evaporated for production of the crystallised salt or electrolysed for production of metallic zinc. See Patent No. 262,546, having the date September 24, 1925.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Notes on "Invar" alloy. *Fer et Acier*, January, pp. 11–12 (in French).

New silver alloys. W. Guertler. *Z. Metallkunde*, February, pp. 68–70 (in German).

The transformation of zinc-aluminium alloys in the solid state. W. Fraenkel and J. Spanner. *Z. Metallkunde*, February, pp. 58–60 (in German).

Some facts about aluminium bronze. W. Bannard. *Brass World*, January, pp. 3–5.

The thermal conductivity and ratio of conduction of alloys in relation to constitution. A. Schulze. *Z. anorg. u. allg. Chem.*, February 4, pp. 325-342 (in German).

ALUMINIUM.—The raw material question on the aluminium industry. *Chem.-Zeit.*, February 2, pp. 89–90 (in German.)

The tensile deformation of large aluminium crystals at crystal boundaries. R. L. Aston. *Proc. Camb. Phil. Soc.*, January 31, pp. 549–560.

Modern technology in producing pig aluminium. R. S. McBride. *Chem. Met. Eng.*, February, pp. 76–83.

ANALYSIS.— A new rapid method for the determination of silicon in steel and pig-iron. J. Verfürth. *Chem.-Zeit.*, February 16, pp. 122–123 (in German).

The determination of small quantities of titanium in highly alloyed steels. K. Roesch and W. Werz. *Chem.-Zeit.*, February 26, pp. 149–150 (in German).

BRASS.—The brittleness of brass on warming. R. Mailänder. *Z. Metallkunde*, February, pp. 44–51 (in German).

CADMIUM.—The production of cadmium. N. F. Budgen. *Continental Met. and Chem. Eng.*, February, pp. 38–41.

ELECTROMETALLURGY.—The theory of the electrolytic separation of chromium from aqueous chromic acid solutions. E. Liebreich. *Z. Elektrochem.*, February, pp. 69–72. E. Müller, *ibid*, pp. 72–76 (in German).

Recent advances in electrochemistry. C. G. Fink. *Mining and Metallurgy*, February, pp. 52–55.

GENERAL.—The solubility of silicon in aluminium. W. Köster and F. Müller. *Z. Metallkunde*, February, pp. 52–57 (in German).

An investigation of the recrystallisation process in silver, copper, and aluminium. R. Glocker and H. Widman. *Z. Metallkunde*, February, pp. 41–43 (in German).

The annealing of metals and alloys in the electric furnace. R. M. Cherry. *Metal Ind.* (New York), February, pp. 55–60.

A cupping test for determining the drawing qualities of thin metal sheets. G. G. Beard. *J. West of Scotland Iron and Steel Inst.*, December, pp. 23–35.

Magnetic properties of evaporated nickel and iron films. R. L. Edwards. *Phys. Rev.*, February, pp. 321–331.

The properties of sodium cyanide copper solutions. W. D. Bonner and B. D. Kaura. *Chem. Met. Eng.*, February, pp. 76–83.

Researches on corrosion at the Imperial German Institute of Technical Chemistry. J. Hauser. *Z. angew. Chem.*, February 17, pp. 198–201 (in German).

The anomaly of the internal friction of reversible ferro-nickels. P. Chevenard. *Comptes Rend.*, February 14, pp. 378–380 (in French).

IRON AND STEEL.—High grade gray iron. H. Pinsel. *Continental Met. and Chem. Eng.*, February, pp. 35–37.

The influence of atmosphere and temperature on the scaling of steel. I. Scaling by air, water vapour, and carbon dioxide. C. B. Marson and J. W. Cobb. II. Prevention of scaling by hydrogen and carbon monoxide. H. T. Angus and J. W. Cobb. *J.S.C.I.*, February 25, pp. 61–72T.

MECHANICAL PROPERTIES.—Hardness and tensile strength. R. Baumann. *Z. Metallkunde*, February, pp. 71–72 (in German).

Stresses involved in tests of hardness, and a table of the comparative hardness of certain metallic elements. A. Mallock. *Nature*, February 19, p. 276.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALUMINIUM CORPORATION, LTD., London, S.W. Registered January 17, £4,600 "C" debentures part of £500,000; general charge. *£1,247,522. August 12, 1926.

TURNER (THOMAS) AND CO. (SHEFFIELD), LTD., steel manufacturers.—Registered January 28, £10,000 2nd debenture (ranking next after 1st debentures), to Bank; general charge. *£80,000. July 19, 1926.

TYZACK (SAMUEL) AND CO., LTD., Sunderland, iron and steel manufacturers. Registered January 27, £18,000 (not ex.) mortgage, to Bank; charged on property in Fulwell Road, Sunderland. *——. December 2, 1926.

Satisfactions

BLAENAVON CO., LTD., ironmasters. Satisfaction registered February 12, £3,100, part of amount registered August 24, 1911.

FRODINGHAM IRON AND STEEL CO., LTD. Satisfactions registered February 11, £40,000, part of amount registered October 12, 1917; and £7,495, part of amount registered June 20, 1925.

Chromium Plating

Work of the U.S. Bureau of Standards

INVESTIGATIONS which have been in progress in America in regard to chromium plating, a subject which has been receiving a great deal of attention in many places, have given rise to some interesting results, according to a recent statement by Dr. W. Blum, chief of the Electrochemical Section of the United States Bureau of Standards. The statement is made public in a research report published by the Engineering Foundation. The work was carried out at the instigation of the United States Bureau of Engraving and Printing, who have been attempting to improve the plates used for printing paper money. The plates in use since 1920 have been prepared by the alternate electrodeposition of layers of nickel and copper.

The Plating of Printing Plates

A study has been conducted at the Bureau of Standards, chiefly by H. E. Haring, upon the possibility of applying chromium to these plates. It is known that chromium is very hard and subsequent tests have shown that, as measured by the width of a scratch produced when a diamond or a sapphire is drawn across it, it is the hardest metal thus far examined. Although the deposition of chromium was reported in 1854 by Bunsen, and numerous papers have been published on this subject, no extensive practical applications of chromium plating were made in America up to 1924. Haring's work showed that to obtain bright hard deposits, such as would be suitable on a printing surface, the conditions of plating must be carefully controlled, especially the acidity and temperature of the solution, and the density of the electrical current. As a result of this study, the process was installed at the Bureau of Engraving and Printing, and has been eminently successful. The printed impressions are somewhat sharper than from the nickel or steel plates. Chromium is said to have been found cheaper than nickel or steel for the purpose. The life of each plate is increased.

Growing Importance of Chromium Plating

Chromium, says Dr. Blum, is now attracting the attention of many manufacturers. Its possibilities lie in its great hardness, and hence its suitability for printing plates, dies, gauges, cams and gears; its high lustre and resistance to atmospheric corrosion, which has led to its application, usually over nickel-plating, on automobile radiator shells, bumper bars, plumbing fixtures and other objects.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

The Properties of Nickel Depositing Solutions

By E. A. Ollard, A.R.C.Sc., A.I.C.

The paper published below was read a short time ago by Mr. E. A. Ollard, research chemist to Metropolitan-Vickers Electrical Co., Manchester, before a meeting of the Electroplaters' and Depositors' Technical Society.

NICKEL is of great interest to the plater because of its colour and resistance to tarnish, which makes it especially suitable for coating the bright parts of bicycles, cars, etc.; and also because it is comparatively cheap. Early attempts, however, to plate the metal were unsuccessful, mainly owing to the fact that commercial salts contained nitrates. The earliest patents were for the exclusion of these salts, and were the subject of much legal action. Many formulæ have from time to time been advanced for nickel plating baths, some being unnecessarily complex, and it has been suggested that one of the activities of any research organisation dealing with electroplating should be thoroughly to test and standardise these. It is not possible, however, to put forward one solution as the best for all purposes, as solutions must be especially made up for the conditions required, and different solutions are necessary in different cases. The object of this paper is to give an outline of usual substances employed in making a nickel solution, together with the effects which may be expected on the deposit and working of the bath from their addition. In general, a nickel bath will contain a salt of nickel to supply the nickel ions for plating, together with conducting salts, buffer substances, salts added to facilitate anode corrosion, and "Addition Agents," and will be maintained at a definite acidity.

Types of Solutions

There are two main types of nickel solutions employed in ordinary shop practice, those made with "single nickel salts," that is, nickel sulphate ($NiSO_4.7H_2O$), and those made with "double nickel salts," or nickel ammonium sulphate ($Ni(NH_4)_2(SO_4)_2.6H_2O$). Nickel cyanide baths are sometimes used, but are not very satisfactory, and it is not proposed to consider them. Complex salts may also be formed by adding magnesium or sodium sulphate to the nickel sulphate, and these baths may be regarded as intermediate between the "single" and "double" salt baths. Chlorides are often added to assist the anode corrosion and increase the conductivity; boric or acetic acid to maintain the constant acidity; fluorides, to maintain acidity and dissolve iron sludge and nickel oxide; and other substances for special purposes.

Baths made entirely of nickel chloride have from time to time been suggested, but do not appear to have any definite advantage over the sulphate bath to which small quantities of chlorides are added. Originally, most nickel solutions were made from nickel ammonium sulphate. Later, the nickel sulphate solutions came into use, and since these possessed some advantages, the former were considered out of date. It has now been shown, however (Macnaughtan, *Iron and Steel Inst.*, 1924), that the two solutions deposit nickel of different structure and mechanical properties, and in making a choice, it is therefore necessary to consider this fact. In general, the nickel sulphate solution gives softer deposits, and works more quickly, thus allowing a higher current density; it is also somewhat easier to control. The nickel ammonium sulphate solution gives a hard deposit, and works more slowly, but the work does not require such careful cleansing, and the deposit may be somewhat whiter in colour. Baths composed of both salts may also be employed to advantage. For most purposes the nickel sulphate baths can be recommended, especially where output is the governing factor. The nickel sulphate is more soluble, allowing higher concentrations, and ionises more completely, so that the nickel ion concentration at the cathode is much higher and higher current density can be used. Solutions containing 3 lb./gall. of nickel sulphate (crystalline) can be employed at the ordinary temperature and allow the use of 20 amp./ft.², or higher, while if warmed to 30° C. 40 amp./ft.² can be used in special circumstances. Most "double salt" baths, however, even when containing nickel sulphate, can only be worked up to 10 amp./ft.², and a correspondingly longer time is therefore necessary. These latter solutions, however, still find a certain amount of favour in some jobbing plating shops, and also have to be used for special purposes where hard deposits are required.

Acidity

The most important factor in nickel solutions is, undoubtedly, the acidity. Since nickel is electro-negative to hydrogen, it would be supposed that if both nickel and hydrogen ions were present together at the cathode, only hydrogen would be liberated. If, however, the concentration of the hydrogen ions is kept very small compared with that of the nickel ions, nickel can be plated quite satisfactorily, with very little hydrogen. The concentration of H ions has to be very carefully controlled. It is usual to express the concentrations of molecules or ions in a solution in terms of the "normality," that is, the number of gram equivalents per litre, but as the hydrogen ion concentration in these cases is very small, this involves the use of unwieldy figures. For this reason, therefore, another system of notation is usually used, the p_H.

$p_H = \log \frac{1}{\text{conc. } H+}$. Thus if conc. $H+ = \cdot 00001$, $p_H = 5$.

On this scale p_H 7 is taken as neutral owing to the dissociation of pure water, the conc. $H+$ of this being $\cdot 0000001$ This system is convenient, but has the disadvantage that the figures vary inversely with the acidity; that is to say, as the acidity increases the p_H decreases. If this is borne in mind, however, the notation may be considered the most convenient, and is now generally adopted. The p_H of most nickel solutions should vary between 5·7—5·9. If the p_H is lower, the current efficiency will decrease, while if it is higher nickel hydroxide may be precipitated. This value refers to the body of the solution, but it is probable that a layer is formed round the cathode of higher p_H. In agitated solutions, therefore, where this layer does not have such a good chance to form, the p_H may have to be raised. There are two main methods of measuring the p_H, (1) by indicators, and (2) by potentiometric measurements. Different indicators change their colour over different ranges of p_H, and by comparison with standard solutions, the p_H can be estimated. The simplest method of doing this is by noting the colour attained by dipping litmus or congo paper in the bath, but this is not very accurate. More accurate methods are obtained by adding indicators to small samples of solutions, and comparing the colours thus obtained with standard solutions made for the purpose. The second method employs the hydrogen or quinhydrone electrodes, the potential being measured against a calomel cell. This is probably the more accurate, but involves more expensive apparatus.

The control of the p_H is of great importance. When it is too high, dark streaky deposits are obtained, whilst when low, the current efficiency falls off, and rough pitted deposits are obtained with a tendency to peel. The control can be effected

by regulating the amount of metal dissolved from the anode, or by additions of acid or nickel carbonate. It can also be helped by the addition of "Buffer" substances to the solution.

Nickel, when made the anode in a sulphate solution tends to become "passive," and therefore, if nickel sulphate is used alone, the bath will work acid. If, however, a little chloride is present the anode will dissolve freely. A very small amount of chloride, ¼ oz./gall., will usually be sufficient for this purpose (either NaCl, NH_4Cl, or $NiCl_2$ can be used), and if this is present, rolled anodes of pure nickel will be found to dissolve quite freely and keep the acidity constant. Large proportions of chloride are often added to increase the conductivity of the solutions. When plating steel, however, this does not seem advisable, as if the work happens to hang in the bath for a few moments without contact, a film of chloride will form on the object which will cause the deposit to strip. A small quantity of chloride, however, may be considered almost essential if rolled anodes are used.

Buffer Substances

Boric acid is another common substance used in nickel solutions. Authorities differ very widely on its effect, some stating that it makes deposits harder, some softer, some whiter, etc. The actual use of this substance is to buffer the p_H, that is, to keep the acidity constant. Boric acid is only weakly dissociated in solution, and therefore a solution will have a low hydrogen ion concentration. A fairly large amount of the acid may therefore be present without lowering the p_H. It must be remembered that the p_H is the "degree of acidity," not the "total acid." The amount of boric acid will allow quite an appreciable quantity of alkali to be added to the bath without the p_H being altered, as it is simply taken up by the undissociated boric acid. This buffer action has the advantage in practice that it facilitates the p_H control, resisting any tendency for the acidity to change. Acetic acid is also used in much the same way. Fluorides have a marked buffer action in the nickel solutions. It is thought that usually they form complexes with boric acid present, but they also produce effects when there is no boric acid present. It is also thought that they help to keep the iron in solution, dissolving the sludge. An addition of fluoride to a nickel sulphate-boric acid bath helps to get an even, fine-grained deposit and to avoid pits. Fluorides, however, contrary to statements made, do not harden the deposit or assist anode corrosion. The addition of fluorides usually tends to give a softer deposit. In nickel ammonium sulphate baths, especially where hard deposits are required, they are to be avoided. Sodium fluoride may be used, or hydrofluoric acid and nickel carbonate.

Baths containing citrates have been proposed especially for plating on zinc and zinc alloys. The citrate is supposed to increase the cathode polarisation, and prevent the re-solution of the metal while it is being covered. Baths containing magnesium or sodium sulphates are often recommended. These substances probably form double salts with nickel sulphate and therefore such baths may be regarded as similar to the "double salt" bath. Since these double salts, however, are rather more soluble, they will work slightly faster, but the deposit is also softer. Addition agents, such as cadmium chloride and organic materials, are sometimes added to nickel baths for specific purposes, such as brightening the deposit. It is extremely doubtful whether such additions are advisable except in unusual and carefully controlled circumstances. Such substances are likely to accumulate in the bath and produce unpleasant results, and there are few cases in which the benefit obtained is proportional to the danger and trouble incurred.

Pits

Organic matter in the bath is thought to be the cause of pitting and the failure of the deposit after heating which is often noticeable. Such matter may come from various sources, dust, etc., impurities in salts, and carbon in anode. Sometimes organisms are actually found to grow in the solution, living on the organic matter present, and themselves producing it and possibly other changes in the solution. One such organism has been isolated and identified as *Fenicillium glucinium*, a fairly common fungus. It is probable that such growths are objectionable and they have usually been associated with pitting in practice. Fluorides, however, seem to prevent them. Impurities, therefore, both in salts and anodes, are to be avoided as much as possible; organic impurities may produce the troubles referred to, while iron is also objectionable. If the p_H is left high, a certain amount of iron in the bath will not produce much effect, but if the solution becomes rather acid it will cause the deposit to split and strip. It also may be associated with pitting. Only pure anodes should be used, and these will be found to dissolve quite freely if chloride is present.

Pitting, when it is likely to occur, may be largely overcome by the addition of hydrogen peroxide, the subject of a recent patent, or sodium perborate. Hydrogen peroxide has the advantage that it yields oxygen and water only. Pure hydrogen peroxide, however, does not keep, and the commercial material often has phosphoric acid associated with it, which is objectionable. Care should be taken if this material is used. Sodium perborate, acidified to the same p_H as the solution, may also be used, but this increases the quantity of boric acid and sodium sulphate in the bath. These substances, however, may sometimes be removed by crystallisation. In general it would seem advisable to prevent pitting by other means if possible, and only to fall back on these methods when essential. Pitting itself is a very complex matter, and while it is essentially due to gas bubbles on the cathode it is by no means clear why it takes place in some cases and not in others. The base metal undoubtedly plays a part, and also the current density, acidity, and composition of solution. It is doubtful whether any one reason can be assigned to it or any one cure suggested. Excluding dust, keeping the temperature constant, not pushing current to the highest limits, and occasionally shaking the articles, are among the means which might be suggested for its prevention.

Properties of Deposits Obtained

The composition of the solution and the conditions under which the deposit is made will have a great effect on the structure and properties of the metal deposited. When metal is deposited on a cathode, the ions discharged by the current crystallise in a manner analogous to the crystallisation of a salt. According to the concentration of ions and the charge they carry, large or small crystals will be found. If the concentration of the ions is high and the charge low, large crystals will be formed, while with fewer ions and a higher charge, small crystals result. Large crystals give a soft metal and *vice versa*. Complex salts ionise much less than simple salts, and therefore the metal ion concentrations will be less and harder deposits will result. Increasing the p_H, increasing the temperature, or reducing the current density, will all tend to soften the deposit, and *vice versa*. There is also a very considerable contraction when nickel is deposited. This is probably due to some mechanism in the formation of the crystals, and the matter is being investigated. It is not of much importance in ordinary plating, but when heavy deposits are made it is sufficient to distort the article on which the deposition takes place.

Throwing power is also an important factor. This depends on conductivity, cathode efficiency and cathode polarisation. In general a nickel sulphate solution throws best, and to get the best conditions the p_H should be kept high and the current density rather low. Conducting salts may also be added.

For most commercial applications of plating it is necessary that the deposit should adhere well to the base metal. The adhesion will depend on the preliminary treatment of the article and the conditions under which the first layer of nickel is deposited. For different materials, different conditions are necessary. For steel, the best treatment is to clean and then make the metal the anode in a bath of 30 per cent. sulphuric acid at a high current density for a short time. The article is then washed and placed in the nickel vat, which should not be too cold, at rather low current density. For brass and copper the article should either be bright dipped or cleaned in cyanide and acid, and washed and placed in at a fairly high current density. To plate on nickel, the article should be made cathode in hydrochloric acid solution and placed in a nickel solution which is rather acid, say, $p_H 5$. Contact should be made as the articles enter the bath and work must not hang in the bath with no current passing.

The colour of the deposits is often of importance. Boric acid, magnesium sulphate, etc., are supposed to affect this, and different authors have ascribed different results to their addition. In general, it seems that a soft deposit appears

slightly darker than a hard. Magnesium salts impart a slightly bluish tint. It is, however, difficult to lay down much on this subject.

Routine Tests

In ordinary shop practice it is necessary to test the solution from time to time, and undoubtedly the most important test is the p_H test. The p_H should be kept constant, and in large shops should be observed daily, while in smaller ones every few days or once a week may suffice. The bath can then be adjusted by additions of the necessary material. It is useful also to estimate the total acid by titration to calculate the quantities of materials required. Other tests are nickel content, specific gravity, and complete analysis and estimation of impurities. Such tests usually need only be applied at intervals or when a bath is not working well. Before, however, endeavouring to remedy defects, all the factors must be carefully examined and conclusions should not be drawn on one test alone, neither can the standardisation of one factor, such as p_H, be looked upon as a cure for all ills. In conclusion, it should be pointed out that plating is a very complex chain of operations. Changing one of these without reference to the others may upset the entire sequence and produce bad results at a much later stage. There are a large number of variables that are very difficult to estimate and control. Thus two experimenters may get different results by the addition of some material due to the different practice in the shops concerned, or the different composition of the solutions. Before making changes, therefore, in any shop practice or solutions, they should be carefully tried out on a small scale under the actual conditions under which they are to be worked, and then cautiously put into operation so as not to upset the routine of the shops more than necessary, should the results not prove satisfactory, and additions to solutions should always first be tried on a small scale.

Typical Solutions

Double Salt.	grms. per litre.
$Ni(NH_4)_2(SO_4)_2.6H_2O$	75
NH_4Cl	15
H_3BO_3	15
Current density, 3-6 amp./ft.².	
For Hard Deposits.	
$Ni(NH)_2(SO_4)_2.6H_2O$	62·5
$NiSO_4.7H_2O$	25
KCl	8
Current density, 10 amp./ft.². p_H 5·6—5·8.	
Citrate Solution : (*Hammond*).	
$NiSO_4.7H_2O$	240
$NiCl_2.6H_2O$	10
H_3BO_3	30
Sodium citrate	175
Single Salt Solution :	
$NiSO_4.7H_2O$	300
H_3BO_3	25
NaF	6
$NiCl_2.6H_2O$	2
Current density, 15-40 amp./ft.². p_H 5·7—5·9.	

Effect of Liquids on Metal Fatigue

Aeronautical Research Committee's Report of a Recent Investigation

The Aeronautical Research Committee has published, as Reports and Memoranda No. 1,054, a paper by Mr. G. D. Lehmann on "The Variation in the Fatigue Strength of Metals When Tested in the Presence of Different Liquids" (H.M. Stationery Office, pp. 13, 1s.). The work described in this paper was performed for the Engineering Research Board of the Department of Scientific and Industrial Research.

The research was suggested by Dr. Haigh, who, in a series of experiments published in 1917 on the "Fatigue of Brass" (*J. Inst. Met.*), stated that he had noticed that fatigue was accelerated in mild steel and other metals when exposed to corrosion by acids, sal ammoniac and salt water; for example, steel structures immersed in salt water and subject to vibration show abnormally rapid fatigue. J. A. Jones, while investigating the action of hot salt solutions upon riveted plates, made a series of tests upon various steels stressed and placed in hot aqueous solutions of chemicals. With some solutions, intercrystalline cracks appeared across the area of maximum stress, the time of appearance varying with the concentration of the solution and the stress sustained by the specimen. Others produced no cracking effect even when corrosion was very marked. No cracking effect was obtained with steels above 0·2 per cent. carbon. Turner and Devons also placed strained specimen of steel in solutions of mercuric nitrate, mercuric chloride and stannous chloride, but no fractures occurred.

The Materials Used

In the present research the following chemical solutions were used in fatigue tests: a solution containing two parts of sodium nitrate to one of water; a solution containing 3 parts of water to 1 of sodium chloride; and a solution containing 3 parts of water to 1 of ammonium chloride. In these cases the tests were carried out while the specimens were immersed in the liquid. In the case of sulphuric acid, s.g. 1·23 at 17° C., the specimens were kept in the liquid for two hours, and then removed and tested. The specimens used were an A.R.C. standard medium steel, containing (per cent.) carbon 0·33, silicon 0·22, manganese 0·59, sulphur 0·057, phosphorus 0·049; and an A.R.C. standard mild steel containing (per cent.) carbon 0·13, silicon 0·18, manganese 0·70, sulphur 0·042, and phosphorus 0·046. The tests run in liquids were carried out in a vertical Wöhler machine of the revolving cantilever type, with single point suspension.

Fatigue tests were carried out and are described in the paper in tabular form, as follows: Fatigue tests in air at 17° C. and in distilled water at 90° C.; of acid pickled samples in air at 17° C.; in sodium nitrate solution and in lubricating oil at 17° C.; in sodium nitrate solution at 96° C.; in sodium chloride solution at 96° C.; and in ammonium chloride solution at 96° C.

Conclusions

The effect of raising the temperature to 96° C. shows a reduction in fatigue strength which is greater in the 0·33 per cent. than the 0·13 per cent. carbon steel. This effect is in the opposite direction to that quoted by Gough (*The Fatigue of Metals*) on a 0·49 per cent. carbon steel.

Acid.—The acid pickling produces a reduction in fatigue strength of 8·7 per cent. in the 0·13 per cent. carbon steel and 8·2 per cent. in the 0·33 per cent. carbon steel: 0·13 per cent. carbon steel, fatigue limit in air at 17° C. 17·2 tons/sq. in., after acid treatment 15·7 tons/sq. in.; 0·33 per cent. carbon steel, fatigue limit in air at 17° C. 18·3, after acid treatment 16·8 tons/sq. in.

Lubricating Oil.—Lubricating oil at 17° C. produces no change in the fatigue strength.

Sodium Nitrate.—The sodium nitrate solution produces no change in the fatigue strength of the 0·33 per cent. carbon steel, either hot or cold. But the hot solution lowers the fatigue strength of the 0·13 per cent. carbon steel by 4·2 per cent.: 0·13 per cent. carbon steel, fatigue limit in sodium nitrate solution at 96° C. 15·9, in distilled water at 96° C. 16·6 tons/sq. in.; 0·33 per cent. carbon steel, fatigue limit in sodium nitrate solution at 96° C. 17·45, in distilled water at 96° C. 17·3 tons/sq. in.

Sodium Chloride.—The sodium chloride solution at 96° C. raised the fatigue strength by 6·35 per cent.: 0·33 per cent. carbon steel, fatigue limit in sodium chloride solution at 96° C. 18·4, in distilled water at 96° C. 17·3 tons sq./in.

Ammonium Chloride.—The ammonium chloride solution at 96° C. lowers the fatigue strength by 16·2 per cent.: 0·33 per cent. carbon steel, fatigue limit in ammonium chloride solution at 96° C. 14·5, in distilled water at 96° C. 17·3 tons sq./in.

Industrial Processes Development, Ltd.

It is announced in the Canadian Press that Industrial Processes Development, Ltd., a new organisation established with head office at Kingston and with connections at New York and London, has been formed. The company has been established by a group of financial and technical men, with the general object of promoting process manufacturing undertakings in Canada and offering a technical service to other companies. The directors are: Dr. F. W. Atack, president; R. T. Elworthy, J. W. Hughson, L. C. Jones. D. McLachlin, Major F. R. Phelan, and H. Spence.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

The Institute of Metals

THE annual meeting of the Institute of Metals passed off very successfully. The Institute has made marked progress during the past twelve months, and is altogether a very live body. Its increasing membership shows that it fulfils a real need. They certainly get value for money, for the *Journal* continues to increase in size, and, even if regard be had to the abstracts of current literature alone, which are of the greatest help to all who feel the need to keep abreast of the times, is well worth the annual subscription. Moreover, members have the opportunity of attending the meetings of the local sections, where the papers read have, as a rule, more immediate and practical interest, for those engaged in practical work, than the more academic type of paper usually presented for reading at the spring and autumn meetings.

Presentment of Research Results

IN many instances, the results of research are not presented in a form in which they can be readily assimilated by the practical man who is to apply them in industry. This is a very important point, as these results are ultimately applied by workers to whom the why and the wherefore of what they are doing is often quite unknown. Nor is it the worker only who requires accurate scientific information in a digestible form. The employer needs, even more than the worker, to have the latest results of research rendered available to him in terms he can understand. It may be objected that the metallurgical expert who conducts research and publishes the results in scientific papers is himself the interpreter of his own results, for the more homely consumption of workshop and foundry. This can only be so when he possesses the gift of clear exposition. That many do not possess that gift is abundantly clear from a perusal of the papers themselves, and of many—too many—of the text-books available. The need of devising some means of making the results of scientific investigation available in simple terms to the bulk of the people concerned in their application is recognised by men of such standing as Sir William Bragg, Sir Ernest Rutherford, and Sir Alfred Mond. It was emphasised strongly at the Institute of Metals dinner.

Bismuth in Copper

Among the papers read at the annual meeting were "The Effects of Impurities on Copper," by Dr. Hanson and his co-workers, and a related paper by Mr. Clement Blazey on "Brittleness in Arsenical Copper." The former dealt both with arsenic and with bismuth; the latter with arsenic alone. In the ensuing discussion, Dr. Rosenhain was careful to point out, and to emphasise, that the section of the research relating to the effect of bismuth dealt with bismuth alone, and that the combined effect of different impurities might be, and in certain cases was, very different from the effect of any one of them when alone. This was by way of reply to Mr. L. Taverner, who thought some of the statements in the paper might be misleading. Dr. R. S. Hutton thought so, too. There is no doubt that others might share in that opinion. Some of the statements in regard to arsenic were also challenged. The discussion tended to show that the admissible amounts of bismuth and arsenic as stated in the paper were too low in actual practice. The whole discussion was illuminating as showing the water-tightness which often exists between the results of a "pure" investigation and practical work. The possible dangers of arguing from particulars to the general, and, perhaps, of the deductive method, as a whole, are well exemplified by these papers. In abstract, where the bald conclusions only are set out, with some unhappy semblance of finality, such papers, even when "interpreted" in simple language, convey impressions which, however justified under laboratory conditions, are distinctly apt to be misleading when applied to the exigencies of day to day practice.

Self Protection in Metals

THE increasing use of light alloys, some of which suffer from the disadvantage of corroding somewhat easily, and the desire to economise in the use of expensive non-rusting ferrous alloys where temperature conditions do not render their use imperative, have greatly stimulated corrosion research and its associated subject, protective coatings. Of the latter the variants are now almost infinite. Apart from pigments, varnishes and lacquers, there are processes of rolled coatings; of spraying, of which metallisation is growing in favour; of sherardising, of coslettising, and of simple dipping, as in the case of tinplate, galvanised sheet, etc. Finally, there is renewed interest in electro-plating, which, when properly done, with fairly thick deposits, is probably the best of all processes of protective coating. Nature, however, has a method of her own, which metallurgists are investigating with interest. It is the degree to which the first oxide, or even sulphide, film may serve to protect the underlying metal from further attack. An oxide film helps to render the metal more resistant to further oxygen attack, for after all, it is oxygen which is the prime agent in corrosion. The protecting film of, for example, alumina, has proved a very effective resistant, on the condition that it is uniform and extends over the entire surface. Discontinuity of the film usually leads to intensified selective corrosion. Dr. Anderson has made some interesting investigations on the alumina film, and believes there are a number of oxides of aluminium involved in its formation. The similar magnesium film is also attracting a good deal of research work abroad.

Cementation by Cyanogen

REFERENCE was made in these columns last month to the researches described in the latest volume of Carnegie Scholarship Memoirs, on Cementation. Interesting results are recorded in the last two numbers of the *Revue de Métallurgie*, by M. Pérot. The experiments described relate to the influence of the pressure of the gases employed in cementation, the duration of the heating, the temperature, the effect of renewing the gases (heating in a current) and the influence of the degree of concentration of the gases employed. From the point of view of the accuracy of the results, the apparatus employed left little to be desired. Although, as the author points out, cementation by cyanogen can hardly be regarded as industrially feasible, owing to the danger and expense attending its use, experiments with the gas were included in the series of investigations described. Cyanide of mercury was employed, but the resulting cyanogen is partly transformed into paracyanogen, with loss of efficiency. The presence of oxygen was carefully guarded against. The dissociation of the cyanogen is greatly in excess of the absorptive capacity of the iron for carbon. It was found, moreover, that a marked absorption of nitrogen took place, although at high temperatures, less is retained. Either an eutectic nitride (Fe N, Fe) or a ternary eutectic (Fe N, Fe-Fe_3C) appears to be present.

The absorption, at 1,000° C., is as great during the first 45 minutes of heating as in the succeeding 3 hours. In a closed atmosphere, therefore, proof is afforded of the loss of activity of the gas in terms of the duration of heating. The influence of pressure appears to be small; if anything, carbon absorption is helped rather than impeded at low pressures. It was found, moreover, that the introduction of the sample was attended, in some instances, by a diminution of pressure, which diminishes correspondingly the dissociation of the cyanogen. At the same time depth of penetration does not appear to be influenced much by the lower pressures. As might be anticipated from the recorded results, which are tabulated in a simple and instructive manner, cementation in a current of gas is much more effective, the gaseous atmosphere being, of course, constantly replenished. The maximum cyanogen concentration can thus be maintained, and carbon penetration is greatly assisted in these circumstances, if low pressures are employed. The research also includes an account of experiments on cementation by means of cyanamide, and by sodium cyanide. The results do not all compare with those obtained when using cyanogen, and neither substance proved as active as the gaseous medium.

The Institute's List of "Trade Alloys"

THE Institute of Metals receives such numerous inquiries for the names of the manufacturers of the thousands of "trade alloys" that exist, that it has been decided to compile a list of "trade alloys" together with particulars of their composition and uses, as well as the names of manufacturers or agents in Great Britain. Persons interested are invited to forward to the Secretary, 14, Members' Mansions, London, S.W.1, the following particulars:—(1) name of alloy; (2) manufacturer or agent supplying; (3) composition; (4) in what form supplied; and (5) uses.

The next election of members is due to take place on April 13. Persons then elected, in exchange for their first subscription, will have the dual privilege of membership for the extended period ending June 30, 1928, and of receiving an extra copy of the Institute's valuable *Journal*. A new booklet descriptive of the aims and objects of the Institute can be obtained from the Secretary, 14, Members' Mansions, Victoria Street, London, S.W.1.

Mining Institute Awards

THE council of the Institute of Mining and Metallurgy have made the following awards:—The Gold Medal of the Institute to Emeritus Professor William Frecheville, A.R.S.M., Hon. M.Inst.M.M., in recognition of his services to the mining industry during a long and distinguished professional career, and to mining engineering education; the Consolidated Gold Fields of South Africa, Ltd., Gold Medal and Premium of 40 guineas to Dr. Sydney W. Smith, A.R.S.M., M.Inst.M.M., for his paper, embodying much original research, on "Liquation in Molten Alloys and its possible Geological Significance"; "Arthur Claudet" Student's Prize of 10 guineas to Mr. Robert A. Mackay, A.R.S.M., Stud.Inst.M.M., for a paper on "The Influence of Superimposed Strata on the Deposition of Certain Lead-Zinc Ores."

Iron and Steel Statistics

THE National Federation of Iron & Steel Manufacturers has issued a new edition of *Statistics of the Iron and Steel Industries*, in which the data are brought up to the end of 1925 (in a few cases 1926). The figures, covering all the important producing countries of the world, deal with every possible aspect of the industry: pig iron, steel ingots and castings, semi-finished and finished steel, wrought iron, iron ore, coal and coke, imports and exports, etc. These main headings are subdivided into many sub-classes. The data for the United Kingdom also include statistics of prices, labour and wages, minerals, etc. This compilation is naturally quite indispensable to all who are in any way concerned with the iron and steel industry. It may be obtained from the offices of the Federation, Caxton House (East), Tothill Street, Westminster, London, S.W.1, price 5s. 4d., post free.

Annual Meeting of Hadfields, Ltd.

SIR ROBERT HADFIELD, moving the adoption of the report and balance sheet at the annual meeting on Monday, at Sheffield, of Hadfields, Ltd., said the increasing severity of the conditions required to be met in the chemical engineering industries was placing greater and greater responsibility on the shoulders of the metallurgist as well as the chemical engineer. High temperature conditions demanded materials of the character quite distinct from that used in the construction of apparatus working at ordinary temperatures and pressures. The phenomenon of heat-scaling provided another example of the urgent call for new materials, and particularly for those possessing resistance to chemical action, necessarily intensified by reason of the high temperatures involved. In this realm of special steels for meeting the several conditions referred to they had made distinct progress, and their heat-resisting steel had been adopted for many parts in no less than sixteen of the new cruisers constructed for the British Admiralty. It had also been adopted for exceedingly important parts of aeroplanes. Discussing peace in industry, Sir Robert said repressive legislation was out of the question; the remedy lay in commonsense and goodwill. Autocratic action was fatal by whichever party it was attempted. Strikes and lock-outs were barbarous symbols of ignorance and intolerance. If we did not check the sequence of upheavals which had disorganised our trade and commerce during recent years, we should cease to be an industrial nation, and consequently be unable to support our population.

Second Report on Atmospheric Corrosion

BEFORE the Faraday Society, on Friday, there was read and discussed the Second Experimental Report to the Atmospheric Corrosion Research Committee (British Non-Ferrous Metals Research Association), by Dr. W. H. J. Vernon. The report was very exhaustive, covering 183 pages. The contents included reports on indoor exposure tests and laboratory experiments (copper, zinc, brass, aluminium, lead, and iron); open-air exposure tests (copper, zinc, and brass, 100 weeks' exposure and 225 weeks' exposure). The First Experimental Report to the Atmospheric Research Committee was presented and discussed at a meeting of the Faraday Society on December 17, 1923. The earlier work was occupied with the systematic examination of the behaviour of the commoner metals on exposure to several types of indoor atmosphere and to the open air, employing both loss of reflectivity and increase in weight to estimate the changes taking place in the metal surface. Probably the outstanding result lay in the recognition of three main types of curve connecting weight-increment with time. In the work recorded in the present report the examination of the various materials has been carried to a further stage; additional (and generally more intensive) experiments have been instituted. These have been concerned chiefly with the mechanism involved in the formation of various films on exposure to air, with particular reference to the conditions under which protective oxide films may be obtained. To this end, attention has been mainly directed upon copper, partly because of its intrinsic importance and partly because of its special predilection to tarnishing.

American Aluminium Production, 1926

THE value of new aluminium produced in the United States during 1926 was $36,583,000, an increase of less than half of 1 per cent. as compared with 1925, according to a statement prepared by J. M. Hill, of the Bureau of Mines, Department of Commerce. Virgin aluminium of 99 per cent. grade was quoted at 28 cents a pound until the middle of July, when a decrease to 27 cents to 28 cents was recorded, which was lowered to 27 cents on September 1, this level being maintained to the end of the year. The 98 per cent. grade was quoted throughout the year at 27 cents a pound. Aluminium bronze powder, as a paint pigment, and aluminium foil were used in increasing amounts. The manufacture of aluminium furniture was further developed during 1926. The electrical industry continued to consume large quantities of the metal, but the automobile industry remained the largest consuming industry. Imports ("general") of aluminium metal, scrap, and alloy in 1926 increased over 72 per cent. as compared with 1925, reaching a total of 74,878,767 pounds, valued at $17,107,690, in 1926. Imports of plates, sheets, and bars increased 24 per cent., amounting to 127,202 pounds, valued at $36,776, in 1926. Hollow ware imports in 1926 totalled 215,265 pounds, valued at $99,458. Total imports of aluminium in 1925 were valued at $10,536,639 and in 1926 at $17,502,435. Exports of aluminium ingots, scrap, and alloys in 1925 were 8,130,222 pounds, valued at $1,835,213, but in 1926 were only 586,749 pounds, valued at $137,980. Exports of plates, sheets, bars, etc., in 1926 were over 56 per cent. greater than the quantity sent abroad in 1925, totalling 7,047,422 pounds, valued at $1,997,107, but exports of tubes, mouldings, and castings decreased 41 per cent. Table and other manufactured ware exported declined 16 per cent. in value, but other aluminium manufactures increased 29 per cent. in value. The total exports of aluminium in 1925 were valued at $6,057,071 and in 1926 at $4,452,303.

Iron Ores of British Columbia

A REPORT on the iron ores of British Columbia and Yukon has just been published by the Geological Survey of Canada. It presents the results of investigations by Dr. G. A. Young in 1922 and 1923 and by Dr. W. L. Uglow in 1924. It contains descriptions of the ore deposits, their mode of occurrence, and the character of the test work done. The economic possibilities of the individual deposits are discussed and estimates of the available tonnage are made in so far as exposures and development work render this possible. Copies of the report may be had on application to the Director, Geological Survey, Ottawa, or to the Natural Resources and Industrial Information Branch, Canadian Building, Trafalgar Square, London, S.W.1.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THERE have been no events of outstanding importance to the iron and steel trade during the month of March, but the trend of events has been interesting enough to those who study the trade, with its tendencies, possibilities, and difficulties. The steel works are still busy, and although the accumulated weight of orders has fallen considerably since the commencement of the year, the decrease has not been sufficient to put a check to the exceptionally high rate of production. The works are all in full swing, and the constant complaint from consumers is still that they cannot get deliveries fast enough. Nevertheless, the orders are being steadily worked off, and there are indications which betoken some uneasiness as to the near future. There is first of all a shortening of the time in which delivery of new orders can be promised. That in itself might not be a reliable pointer. It is known that more than one of the steel works are promising quicker delivery of new orders at higher prices than of the older orders placed against pre-strike contracts, and when one is estimating the significance of the improved delivery this must be taken into account. But when that has been done, the fact remains that unless there is a material change, the order books will soon assume the proportions to which we had so long been accustomed.

Prices and Internal Competition

This is confirmed by two other items of evidence: first, the trend of prices; secondly, the revival of internal competition. During the month, the associated steel makers held a meeting at which the question of prices was thoroughly discussed, and the decision arrived at was that there should be no change in the official prices. It is difficult to see what other decision could be made. It would obviously be no use increasing prices, much as that step may be needed. New business of any weight is already difficult to get, and the fear is that an increase in price would act as a further deterrent. That is a condition for which the steel makers have largely to blame themselves.

The experience of the past five years has shown the consumers quite clearly that they are the masters of the situation, that owing to the excess productive capacity they will secure lower prices by holding back their orders as long as possible. On more than one occasion during the unsatisfactory period which has followed the war, the opportunity has been there for arresting the continual fall in selling prices of steel, for indicating that the bottom really had been reached, and a moderate advance would have done no harm. It would not have held off orders; indeed it would probably have brought out more business. The opportunities were not taken, and excepting for the few weeks at the commencement of 1926, the movement has been steadily downwards, until the belief is generally held that there is really no bottom to steel prices. It was only the abnormal conditions created by the strike that gave the works a chance of putting prices up, but that is of little use to the trade. Any advance that may have been obtained due to the strike has been swallowed up in the extra cost due to the same cause, to say nothing of the huge losses which piled up during the stoppage.

The Need of a Price Level

What has been wanted for a long time is the fixing of steel prices at a level commensurate with the cost of manufacture, and while this may not be possible when the export trade is in question or when foreign competition is being met, there is a large volume of home trade for which better prices could and would have been paid if necessary. Instead, however, of a firm stand being taken and prices maintained at a figure approaching an economic level, when it could without question have been done, the scramble for orders was too keen, and the steel trade was sacrificed for the benefit of the consumer. That advantage has been maintained by the consumer, apart from the artificial period during the strike, and there appears to be no hope of anything different until either the British steel works limit their productive capacity, voluntarily or compulsorily, and bring it more into line with the regular normal demand, or some international conditions arise which will stimulate the demand, as did the great war.

Until one or other of these things happens, the steel makers look like having to dance to the tune called instead of themselves calling the tune. Take the motor trade, for instance. The public generally has been astonished and gratified by the very low prices at which the popular makes of cars can be obtained, but to a large extent these low prices have been made possible by the steel works, not from choice, but out of necessity. The motor firms issued an ultimatum to the makers of the parts that they expected a stipulated reduction in the price of these parts; this in turn was passed on to the steel works, and because orders were wanted, the steel makers offered little or no resistance, but accepted the orders.

Orders at any Price

That is indicative of the position as it was before the strike, and as it soon will be again, when the accumulated orders have been wiped off. That is why no official increase in price is likely. Indeed, the tendency is the other way. What else can be expected when, instead of production being reduced, new works are built to add to the already fierce competition? The effect of the entry of the Appleby Co. into the field is making itself felt. In January and February the price of steel plates was fairly firm round £8 15s. to £8 17s. 6d. in Lancashire and the Midlands, although the official association price was only £8 7s. 6d. These prices could be seen quoted in the trade papers week after week, even when they were no longer in force. During this time, in order to get work for the new mills, Appleby were quoting the association price of £8 7s. 6d. Towards the end of February it was found that £8 12s. 6d. would be readily accepted by the other works, and soon £8 10s. became the price: now £8 7s. 6d. is the price generally quoted by most of the makers. The Scottish makers are quoting that price for delivery into the Midlands, with a railway carriage of roughly 30s. per ton, leaving a net works price of £6 17s. 6d.! There is no works in the country that can make plates at anything like that figure, but the necessity to get orders to keep the plant running dictates the policy of "orders at any price."

Coke Prices

Another point to be noted is that as soon as there is the slightest easement in the cost of manufacture, it is at once demanded that the price of steel shall be correspondingly reduced; and if past experience is any guide, the demand will be granted. Unfortunately there does not seem to be any likelihood of lower costs in the immediate future. Coal prices have certainly slackened a little, and the benefit of buying fuel in spot lots as it is required is still being realised. The price of coke, however, is moving the other way. The official price in January for blast furnace coke was 20s. at the ovens, although many contracts were made at 19s. or even less. For the next quarter the price has been advanced to 22s. at the ovens, and the coke makers are resisting all the appeals for lower prices. They have the whip hand at present, and they are taking full advantage of the situation.

Iron and Steel Market

The general condition of the iron and steel market may be described as quiet. In all sections the report is the same, that the scarcity of new business prevails. Buyers do not seem to be impressed with any feeling of confidence in the stability of present prices, and are therefore merely buying from hand to mouth, and working off the old contracts. They are waiting for lower prices, and their action—or to put it more correctly their inaction—will no doubt have the effect they desire. Continental prices have already receded, particularly in semi-finished steel, but there is not any great weight of business being placed. It was interesting to read of a consignment of several hundred tons of Continental steel plates being delivered to the North East Coast quite recently. That was, indeed, taking coals to Newcastle, but no doubt the consignment was a relic of the strike purchases.

The production of pig iron in February amounted to 567,900 tons, compared with 434,600 tons in January. Steel production amounted to 819,100 tons, compared with 730,700 tons in January. There were 15 more blast furnaces working than at the end of April, 1926.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Electrolytic Processes

ACCORDING to a patent by E. C. R. Marks, London, from the Grasselli Chemical Co., Cleveland, Ohio, U.S.A., cadmium is deposited from solutions containing, besides cadmium, an ammonium compound, a cyanide, and an alkaline agent. Under these conditions, the deposition of zinc is inhibited so completely that the method may be applied to the quantitative determination of cadmium in presence of zinc. In the latter case, after the cadmium has been deposited, caustic alkali is added and the solution is boiled to expel ammonia, and electrolysed again for deposition of the zinc. When the method is used for cadmium plating the usual additions of colloids may be made to the bath. The cadmium deposits so obtained are stated to be more resistant to corrosion than cadmium deposits containing zinc. See Patent No. 265,292, having the date November 4, 1925.

The Siemens and Halske Akt.-Ges., Siemenstadt, Berlin, find that copper can be refined by electro-deposition from a cuprous chloride electrolyte. The electrolyte is either continuously or at intervals removed from the electrolytic cell, oxidised to cupric chloride by blowing in air or chlorine, and treated with metallic copper, which is thereby dissolved with formation of cuprous chloride, which is returned to the cell. The method is particularly applicable to the refining of alloys containing a considerable proportion of foreign metals, such as an alloy containing 70 per cent. of copper, 20 per cent. of nickel, and 10 per cent. of zinc.; after deposition of the copper the other metals are also removed, either by electrolysis or by chemical methods. See Patent Application 264,116, having the International Convention date March 6, 1926.

In Specification 259,118 (see THE CHEMICAL AGE, Vol. XV, p. 39, Metallurgical Section) R. Appel, of Berlin, described a chromium plating process in which was used a dilute solution of chromic acid containing a little sodium sulphate as electrolyte, in conjunction with anodes of dense lead (rolled lead). According to a Patent of Addition the inventor now finds that the addition of sodium sulphate, potassium sulphate, bisulphate, phosphates, and similar electrolytes, can advantageously be increased to 0·5–1 per cent. by weight of the bath; very firm adherent coatings are obtainable. See Patent No. 265,833, having the date May 17, 1926.

W. Würker, of Leipzig, Germany, finds that an addition of a small quantity of an alkaline earth, or heavy metal electrolyte, enables the deposition of chromium to take place at very much lower current densities. The metal is thus deposited satisfactorily in the recesses of irregularly shaped objects. Titanium sulphate, aluminium sulphate, and magnesium sulphate are specified as suitable additions, but the use of copper, zinc, or nickel compounds is excluded. See Patent No. 266,045, having the date November 16, 1925.

Iron

ACCORDING to a Patent by P. C. Rushen (London), from the Gelsenkirchener Bergwerks Akt.-Ges., Gelsenkirchen, Germany, phosphorus can be eliminated from pig iron by treatment with carbon monoxide, in the presence of basic material, if the iron is maintained at a temperature only slightly above its melting point. This temperature is the most favourable for the oxidation of the iron phosphide by the carbon monoxide, iron phosphate being produced which yields calcium or other phosphate with the basic material present. See Patent No. 266,033, having the date November 12, 1925.

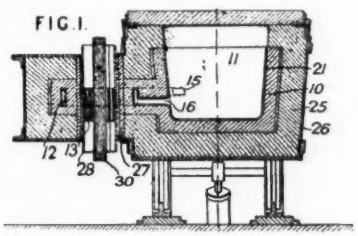
Extracting Precious Metals

THE Mond Nickel Co., Ltd., and R. H. Atkinson, London, describe a process for isolating precious metals from ores and concentrates, in which the latter is heated in a reducing atmosphere with metallic lead and either zinc or an alloy containing zinc; a small amount of a chloride, such as ammonium chloride, is added as a flux to the surface of the metal to keep it clean. When cool, the lead which contains the precious metals is separated and treated by a method similar to the Parkes process (*i.e.*, melting with zinc and removing the crust) for the isolation of the precious metals. If the ore contains iron, metallic iron is found in the residue and retains most of the precious metals not taken up by the lead and zinc; it may be separated magnetically and treated in any known manner. An example is given of the treatment of a Lydenburg platinum ore containing gold, platinum, palladium, iridium, osmium, rhodium, and ruthenium. See Patent No. 266,040, having the date November 14, 1925.

Electric Furnaces

THE British Thomson-Houston Co., London, as assignees of M. Unger, Pittsfield, Mass., U.S.A., describe an electric induction furnace suitable for maintaining a metal in the molten state for a considerable period. Heating currents are induced in a looped portion of metal forming a closed secondary, circulation of the metal being effected by electromagnetic repulsion. The crucible 11 communicates with an annular channel 12 by ducts 15 and 16, the latter being centrally disposed between the side ducts 15 and at a lower level. On the central limb of a core 30 is carried the primary

FIG. 1.



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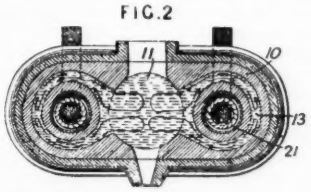
winding 13, with its centre below the plane of the channel 12. The crucible has an insulating lining 25 and an inner lining of magnesia 10; it is at first provided with a metal lining 21, which melts out when the first charge is run in. See Patent Application 263,856, having the International Convention date December 31, 1925.

In a second application the same firm describe a similar furnace, which consists of a crucible 10 with a reservoir 11 and one or more looped channels 13. Primary windings 21 induce

FIG. 2



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currents in the charge in the channels, which are elongated in one direction to increase the circulation due to electromagnetic repulsion. The ratio of the width of the channel to its depth is 2 : 1 and 4 : 1 in furnaces for treating copper and iron respectively. See Patent Application 263,857, having the International Convention date December 31, 1925.

Zinc

THE "blue powder" obtained as a by-product in lead-refining is commonly treated for recovery of zinc by fusing with zinc chloride, which dissolves zinc oxide and permits the particles of metallic zinc to melt together. According to a patent by E. C. R. Marks, from the American Smelting and Refining Co. of New Jersey, U.S.A., the slag resulting from this process is heated in a muffle to volatilise the zinc chloride which is collected and used again. The residue contains chiefly zinc oxide. See Patent No. 265,036, having the date April 7, 1926.

Improved Treatment of Tin Ores

CLAIMS have recently been made for new methods of working in lode tin mines, whereby an increased yield of tin oxide may be obtained. The methods are said to be especially applicable to the slime left after the main treatment of the crude ore, it being claimed that 85 to 90 per cent. of the tin content of the slime can be recovered, and that the process can be applied to discarded waste from ore-dressing plants containing 10 to 15 per cent. or even less of tin. The substantiation of these claims would have important results on tin-mining industry in Cornwall.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Magnesium-silver alloys. P. Lafitte. *Bull. Soc. Chim.*, January, pp. 32-34 (in French).

The binary alloys of lead with lithium up to 2·2 per cent. of lithium. J. Czochralski and E. Rassow. *Z. Metallkunde*, March, pp. 111-112 (in German).

Determinations of hardness and measurements of potential of zinc-copper alloys. O. Bauer and O. Vollenbruck. *Z. Metallkunde*, March, pp. 86-89 (in German).

ANALYSIS.—The determination of phosphorus in phosphorus alloys. B. Salkin. *Ind. Eng. Chem.*, March, pp. 416-417.

A simplified method of determining molybdenum in steel and iron. E. Färber. *Chem.-Zeit.*, March 5, p. 171 (in German).

CORROSION.—The corrosion of tin plate in tin cans. C. L. Mantell and E. S. Lincoln. Canadian *Chem. and Met.*, Februaiy, pp. 29-31.

Controllable variables in the quantitative study of the submerged corrosion of metals. O. B. J. Fraser, D. E. Ackermann, and J. W. Sands. *Ind. Eng. Chem.*, March, pp. 332-338.

GASEOUS CEMENTATION.—A contribution to the study of gaseous cementations. Cementation by means of cyanogen. M. Pérot. Part I, *Rev. Métallurgie*, January, pp. 23-35. Part II, *ibid*, February, pp. 79-92.

GENERAL.—Passivity. H. Eggert. *Z. Elektrochem.*, March, pp. 94-102.

A note on the diffusion law as applied to diffusion in solid solution. J. S. Dunn. *J.S.C.I.*, March 25, p. 109T.

An electric furnace with a revolving arc. G. E. Evreïnoff and S. Y. Telny. *Rev. Métallurgie*, February, pp. 57-63 (in French).

IRON AND STEEL.—The manufacture of steel. V. Nocent. *Bull. Soc. Chim. Belg.*, January, pp. 10-23.

The decomposition of the austenitic structure in steels. I. R. L. Dowdell and O. E. Harder. *Trans. Amer. Soc. Steel Treating*, February, pp. 217-232. Deals with the general plan of the investigation, with the steels used, and with the decomposition of austenite during quenching.

The wear resistance of carburised steel versus cast high manganese steel. W. J. Merten. *Trans. Amer. Soc. Steel Treating*, February, pp. 233-244. Discusses the determination of the comparative wear resistance of 14 per cent: manganese cast steel and case-hardened steel when subjected to relatively high pressure with movements free from shock or pounding.

Evidences concerning the location of the carbon atom in boydenite. H. A. Schwartz. *Trans. Amer. Soc. Steel Treating*, February, pp. 277-283. A contribution to the study of graphitisation. Support is offered for the view that solid solutions of carbon in iron in equilibrium with iron (boydenite) and with cementite (austenite) are essentially different in kind.

Solidification of steel in the ingot mould. A. L. Field. *Trans. Amer. Soc. Steel Treating*, February, pp. 264-276. The linear rate of solidification of steel and the location and shape of the shrinkage cavity are treated mathematically.

Constructional silicon-steel for the Siemens-Martin oven. J. Meiser. *Stahl u. Eisen*, March 17, pp. 446-448 (in German).

METALLIC SYSTEMS.—The system tin-copper-antimony. W. Bonsack. *Z. Metallkunde*, March, pp. 107-110 (in German).

Contribution to our knowledge of the binary system cobalt-tungsten. W. Geisz and J. J. van Liempt. *Z. Metallkunde*, March, pp. 113-114 (in German).

The possibility of considering the existence of limit states in the study of alloys. The study of an equilibrium diagram permitting of the existence of limit states. L. Grenet. *Rev. Métallurgie*, February, pp. 93-107.

SINGLE METALS.—The influence of the conditions of separation on electrolytic copper. V. Rothert and A. Tuteur. *Chem.-Zeit.*, March 23, pp. 219-220 (in German).

The structure and tenacity of very pure aluminium. F. von Göler and G. Sachs. *Z. Metallkunde*, March, 90-93. An investigation of the structure by X-ray methods, and of the mechanical properties. Gold in sea-water. F. Haber. *Z. angew. Chem.*, March 17, pp. 303-314 (in German).

The production and refining of remelted zinc. E. R. Thews. *Metal Ind.* (New York), February, pp. 60–62.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[***NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.***]

BRITISH PLATINUM AND GOLD CORPORATION, LTD., London, E.C. Registered March 4, £50,000 participating convertible debenture stock and premium of 5 per cent. (secured by trust deed dated March 3, 1927), present issue, £41,875; general charge. *——. January 13, 1926.

CLARK (F. A.) AND SON, LTD., London, W., lead merchants. Registered February 21, £37,500 first debentures and £15,000 second debentures; general charge.

INDIAN COPPER CORPORATION, LTD., London, E.C. Registered February 26, £350,000 debentures and bonus of 5 per cent. (secured by trust deed dated February 23, 1927); charged on certain mining leases, etc.; also general charge (except a certain quarrying lease). Nil.* July 22, 1926.

PENA COPPER MINES, LTD., London, E.C. Registered March 14, £50,000 (not ex.) mortgage to bank; charged on mines, lands, etc., in Spain as mentioned in schedules to the particulars, etc. *£16,891 10s. 8d. October 6, 1926.

Satisfactions

COALBROOKDALE CO., LTD., coal and ironmasters. Satisfactions registered March 14, £29,300, balance of amounts registered March 4, 1902, to June 16, 1910; and £32,000, registered December 8, 1909.

CROGGON AND CO., LTD., London, E.C., metal manufacturers. Satisfaction registered February 28, series of debentures for £15,000 authorised November 1, 1887, of which £13,900 was issued, fully satisfied.

POLLARD (JAMES), LTD., Burnley, ironfounders. Satisfaction registered March 14, £3,400, registered October 2, 1905.

ROBINSON (GEORGE) AND SON, LTD., London, E., metal merchants. Satisfactions registered March 1, £3,000, registered May 23, 1907; all moneys, etc., registered December 22, 1920; £5,000 registered February 19, 1921; and all moneys, etc., registered January 29, 1925.

Proposed International Zinc Cartel

PRELIMINARY negotiations are said to have been begun between the Belgian Vieille Montagne and the German Mansfeld group with regard to the formation of a zinc cartel. The supposed aim is not so much the formation of a sales syndicate as an agreement on production quotas between the European producers. It is hoped also to arrive at agreements with the Americans as to the quantities exported to Europe. In other words, the idea is to apply the system of the International Raw Steel Union to the zinc industry. The participants hope to make corresponding agreements in the near future with the Belgian, British, German, French, and Dutch firms; negotiations will probably be carried on in Brussels. It is hoped that it will be possible to bridge over the old difficulties between the British and Belgian producers over the question of quotas. There are also hopes of arriving at an agreement with the American Zinc Export Association, as the Anaconda group has a big interest in Upper Silesia through Giesche. The German view is that an international agreement on these lines would get rid of all the source of friction between the various German and Polish interests which led to the dissolution of the old syndicate.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, The Chemical Age, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Metallurgy and Uses of Tungsten

By G. Malcolm Dyson, Ph.D., A.I.C.

In the following, Dr. Malcolm Dyson continues the series of articles, on the metallurgy and uses of various metals, which have appeared in this supplement at intervals.

Tungsten, in the form of its ores, is comparatively widely distributed throughout the earth's crust, but it was not until 1781 that Scheele, to whom we owe the discovery of many of the elements, drew attention to the existence of tungstic acid, distinguishing it from the various acids already known. He observed it in the mineral scheelite (calcium tungstate), and commented upon its heaviness. The application of the new metal, and its compounds, to commerce was slow, and although Oxland in 1847 and 1857 took out patents which protected the production of ferro-tungsten alloys, it is evident that the value of such alloys was not by any means fully realised. Among the earlier applications of tungsten compounds we may mention the fireproofing of fabrics by treating them with sodium tungstate solutions. Tungstic oxide finds use in the ceramic art for the colouring of china and glazes, but the bulk of tungsten is used for the production of alloys of various kinds and filaments for thermionic valves, etc. In this connection it is curious to note that the old sword blades of

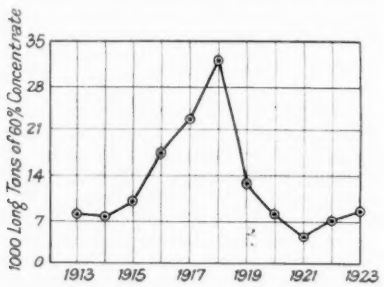


Fig. 1.—World's Output of Tungsten Ore.

Damascus steel, held to be incomparably superior to all others, have been found to contain tungsten—obtained, it is hazarded, from the hardening mixture used.

Tungsten occurs mainly in the older Plutonic rocks and the alluvium which their disintegration furnishes, the two principal minerals being scheelite and wolfram (or wolframite), the latter term covering a whole series of isomorphous mixtures of iron and manganese tungstates. When the iron tungstate content is below 20 per cent., the mineral is termed Hübnerite, whilst if the manganese tungstate falls below this figure the name Ferberite is used. The bulk of the deposits appear to be distributed through Asia, Burma yielding a good output of excellent ore, whilst China, although its deposits are only of recent discovery, furnishes at the present time one-half of the world's supply; Australia has mixed deposits of scheelite and molybdenite, which are to be found in Queensland and Tasmania; the United States is well provided by extensive deposits of wolfram in Colorado and California, whilst in South America a considerable quantity of low grade ore was mined at one time in Bolivia. The world's output of tungsten ores, shown in Fig. 1 above, fluctuates considerably, and it is particularly noticeable that the war period was followed by considerably decreased production.

Tungsten ores are usually deposited in very small veins, and it is the exception to find massive deposits. Consequently much gangue is obtained along with the ore, and the first crude ore mixture contains only from 1 to 2 per cent. of tungsten. By crushing and tabling this can be considerably increased, and after a magnetic separation to remove tin ore (cassiterite) the concentrates contain 60 to 70 per cent. of WO_3. Scheelite, on the other hand, is non-magnetic and cannot be so separated. Fortunately, however, it occurs most frequently with garnet, which being magnetic is easily separated from the more valuable tungsten ore. Average analyses of wolfram and scheelite reveal the following:—

Ore.	Wolfram.	Scheelite.
WO_3	73–75	70–80
FeO	9–11	—
MnO	12–14	—
CaO	0–1	16–20
SiO_2	0–1	0–10

Extraction of the Metal

The first step in the production of the metal is the preparation of a fairly pure tungstic oxide, WO_3. Methods of preparation of this substance vary according to the mineral employed as the raw material, and according to the purpose for which the metal is destined. Where the metal is to be used in the preparation of filaments, etc., for lamps, valves, etc., the utmost purity is desirable, since traces of impurity have an adverse effect upon the ductility. Oxide destined for the production of ferro-tungsten need not be so highly purified.

Where the ore is wolfram, some modification of the fusion method is the usual preliminary process. The ore must be ground very fine and mixed with ground sodium carbonate in the proportion of 1 cwt. 82 lb. of the former to 2 cwt. of the latter. The mixture is run through a ball mill to ensure intimate contact, and then fired on the hearth of a small gas-heated reverberatory furnace at 800° C. for 2 to 2½ hours. During the fusion the mixture must be well rabbled, to ensure sufficient contact with the atmospheric oxygen to oxidise completely the iron and manganese present. Such a process is intermittent, and not particularly well suited to large scale production, and has for this reason been replaced in larger plants by a continuous process involving a rotary shaft furnace. The intimate mixture of ore and alkali from the ball mill is fed into the top of the shaft, which is gas- or oil-heated to about 1000° C. At this temperature the melt flows fairly readily and fresh surfaces are exposed to the oxidising influences of the atmosphere as the shaft rotates. The melt in this type of plant falls straight into the water, and is stirred therein until the liquor attains a S.G. 1·7 at 80° C.

Various modifications of the process have been devised. With ores containing any appreciable amount of calcium, it is usual to add the calculated quantity of silica to ensure conversion of the calcium into insoluble silicate. Other additions, of rather more debatable advantage, are the use of salt, sodium sulphate or sodium nitrate in the melt. The salt acts not only as a solvent for the alkali, thus ensuring more intimate contact between the latter and the particles of ore, but also makes the melt more fluid and promotes oxidation. To effect the latter is also the function of any sodium nitrate addition, which considerably shortens the length of heating and leads to an increased yield. In the proportion of about 4 per cent. of the ore's weight, it is now a recognised addition to the mixture for shaft furnace treatment. The advantages of the addition of ground salt cake in place of part of the alkali are three: (1) The melt proceeds more

rapidly; (2) the cost of salt cake is less than that of sodium carbonate; and (3) less acid is required in the neutralisation. Proposals have also been made to leach out the tungsten compounds from the ore by strong caustic soda solution. Here the ore must be ground to a very fine powder. The ore is boiled with constant stirring for seven to eight hours with rather more than half its weight of caustic soda in water equal in weight to that of the ore used. The liquor, after standing, can be siphoned off.

By whatever means the sodium tungstate liquor is prepared it is usually worked up by one of the three methods following. Concentration and cooling yield crystals of sodium tungstate, and precipitation with hydrochloric at the boil gives a granular form of tungstic oxide, WO_3, of tolerable purity. The most favoured method is, however, through the intermediate use of the calcium salt. Calcium chloride solution is run into the sodium tungstate liquor and the precipitated calcium tungstate is allowed to sediment and is washed by re-sedimentation. The sludge is run direct into a boiling mixture of equal parts of concentrated hydrochloric acid and water. The tungstic oxide which is precipitated contains about 95 to 96 per cent. of the oxide.

Where scheelite is the mineral used, the procedure is slightly less complicated. The well-ground ore, containing about 1 per cent. of ground pyrolusite to ensure complete oxidation is mixed with concentrated hydrochloric acid at 80° C. in the proportion of three parts of the former to five parts of the latter. Stirring is continued at 80° C. for several hours, after which the whole is poured into water (10 parts), which is kept briskly boiling. The residual tungstic oxide can, of course, be removed by filtration. A further method of treatment for scheelite is the heating of the ore in a current of phosgene, when tungsten chlorides sublime leaving calcium chloride behind. The method is not yet of commercial importance.

The crude 95 to 96 per cent. tungstic oxide prepared by the above processes is good enough for the production of tungsten for alloys, but for the more refined work a purer oxide is required. Here, again, several methods are available. Possibly the most effective one is that which involves solution and reprecipitation from ammonium hydroxide solution. The crude oxide is heated with four-fifths of its weight of ammonia solution (S.G. 0·880) and stirred for some time. The insoluble impurities are allowed to settle, the clear solution of ammonium tungstate is siphoned off and if necessary filtered. The clear liquor is allowed to run into two-thirds of its weight of dilute hydrochloric acid (S.G. 1·2). This acid is contained in large silica pots, and is maintained in a state of violent ebullition during the addition of the alkaline liquid. Only by so doing can the precipitated oxide be obtained in a granular form suitable for filtration and rapid washing. The purified oxide should now contain less than 0·1 per cent. of iron (as Fe_2O_3) and about 0·05 per cent. of CaO, whilst very minute traces of other metals are often present. It is not possible to remove all the iron from tungstic oxide, even by repeated reprecipitation, owing to the tenacity with which ferric salts are adsorbed by the precipitate. Further purification can be effected through the basic ammonium salt which crystallises out when the ammoniacal solution of the crude oxide is concentrated slightly and allowed to cool. Crystals of $5(NH_4)_2O,12WO_3,xH_2O$ (x being a variable quantity) separate out and by heating to 250° C. can be completely decomposed, leaving tungstic oxide in a fairly high state of purity.

Reduction to the Metal

The easiest and most widely practised reduction process, where the purity of the metal is not of paramount importance, is the reduction with charcoal. The oxide is milled with 12 to 14 per cent. of lampblack and a little oil or resin, and the paste moulded into small pieces, which are placed in a series of Morgan clay crucibles. The covers being luted on, the pots are slowly heated up to as high a temperature as the pots will stand (1200 to 1300° C.). The heating-up takes about 8 to 10 hours, whilst the actual reduction takes another 8 hours. The crucibles are cooled before opening. The tungsten powder can be readily washed free from particles of carbon.

Reduction by hydrogen is always practised where the pure metal is required. As might be expected from the polyvalent nature of the element, the reduction takes place in a number of distinct chemical stages in which the following compounds have been isolated:—

Tungsten trioxide	WO_3	Yellow.
——	W_2O_5	Blue.
Tungsten dioxide	WO_2	Chocolate.

There are several vital factors in the production of a suitable tungsten powder, especially with regard to the size of the particles formed. The state of the oxide with regard to its subdivision, and more particularly the temperature used, play an important part. The effect of the temperature on the particle size can be seen from the following graph.

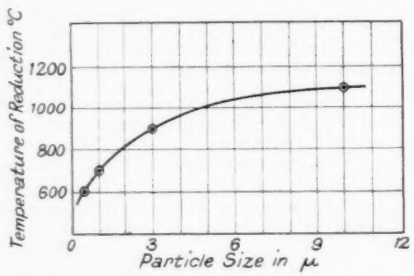


FIG. 2.—VARIATION IN SIZE OF TUNGSTEN PARTICLES WITH TEMPERATURE OF REDUCTION.

It is usual to arrange the temperatures of reduction so that particles of average size 1 to 3 μ are formed. In practice the reduction is performed in two stages—heating first at 700° C. for a period of 2 to 3 hours to reduce to the tungsten dioxide stage. This is cooled in a current of hydrogen, mixed with an equal weight of tungsten trioxide, and the reduction to the metal completed at 750 to 950° C. The diagram (Fig. 3)

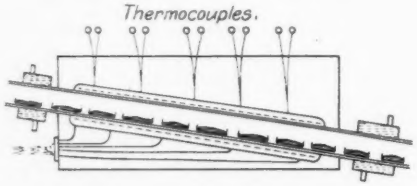


FIG. 3.—FURNACE FOR REDUCTION OF TUNGSTEN TRIOXIDE TO TUNGSTEN.

shows the type of apparatus used in a continuous plant for the production of tungsten. The silica tube is about thirteen feet long, and is heated in a resistance furnace wound in sections—thus allowing for a temperature gradient along the tube. The dried oxide is spread in a thin layer in a nickel boat and passed through the furnace in a direction opposite to that in which the hydrogen is passing. The ends of the tube are water cooled to allow the boats to return to the room temperature before they are removed from the tube. The temperature gradient is adjusted to rise from 500 to 700° C. as the boats pass through the first furnace where the chocolate coloured oxide is produced, whilst in the second tube, where complete reduction to the metal is effected, the gradient is from 650 to 780° C.

In addition to the processes just mentioned, much research has been done on the electrolytic production of metallic tungsten, but with very little practical result. Electrolysis of aqueous solutions of various tungsten compounds seems incapable of yielding anything but the lower oxide. Electrolysis of the fused tungstate seems to be a more feasible method, and by very careful regulation a powder containing 99·3 per cent. of the metal may be obtained. The production of the massive form of the metal does not seem to be possible by this method. During electrolysis of the alkali tungstates complications may arise from formation of "tungsten bronzes." These are curiously inert substances of the general formula R_2O, WO_2, nWO_3 which may be prepared by quite simple means, and are used in the preparation of commercial bronze

powders. When R in the above formula is Na, the colour alters from gold to violet as n increases, thus :—

Colour	n
Gold	1
Red	2
Violet	3
Blue	4

In order to prepare the metal for filament drawing, the powder has to be transformed by a somewhat laborious process into ingots. It is pressed, with or without a small quantity of bonding material, into small bricks, at a pressure of 20 to 30 tons per sq. in., and sintered on a graphite slab at 1,000° C. for half an hour, during which a shrinkage and toughening of the ingot takes place. The ingot is then " formed " into a more or less compact mass by the passage of a heavy current. It is placed between water-cooled contacts and a current of about 1,500 amps at 10 volts passed, the current being adjusted to raise the temperature to just short of the melting point. The ingot is then hammered persistently at a high temperature —an operation known as " swaging."

Properties of the Metal

Tungsten is a dull white, somewhat malleable element which has probably the highest melting point of any metal. It melts at 3,600—3,700° C. Its refractory nature has led to its use in the manufacture of filaments for electric light bulbs, a considerable increase in efficiency being obtained in comparison with other metals. In the so-called " half-watt " lamp it is implied that for each candle power emitted 0·5 watt is consumed, but such efficiency is only found with the higher powered lamps, the energy loss by radiation, etc., from the smaller lamps entailing the consumption of 1·0 to 1·3 watts per candle power. The various forms of " Pointolite " lamp involves the use of tungsten arcs, but the true tungsten arc is obtained between horizontally held pencils of the element. Such pencils burn away very slowly and the light obtained is particularly rich in ultra-violet rays of 4,000 to 2000 A.U.

The chief use of tungsten, apart from filaments, is in the production of alloys, and also for the production of X-ray targets and suspension fibres for moving-coil galvanometers. Of the alloys, the high speed steels are of considerable industrial importance. The average composition of such a steel (shown in column I of the following table)

	I	II	III
W	13–18	8	3–10
Cr	2·5–6·5	2	40–35
C	0·55–0·65	0·7	0·2
V	0·3	—	—
Co	—	40	55
Fe	74·5–84	49·3	—

shows a considerable proportion of tungsten. The alloy retains its hardness and cutting properties at a red heat, as also does the alloy " stellite " (III in the table), a non-ferrous cutting metal. The permanence of this latter alloy has led to its use in the manufacture of metallic reflectors. The addition of tungsten to steels used in making permanent magnets increases the efficiency and permanence. The value of a magnet steel may be expressed as the product of its permanence and coercive force. Although the permanence is reduced slightly by alloying with tungsten, the coercive force is greatly increased, especially with alloys such as Honda's cobalt steel, the composition of which is given in column II of the above table.

Notes on Lead Slag Manipulation

(From a Correspondent)

One of the principal fluxes used in the lead blast furnace is old slag from previous heats. These are charged, not only to recover the lead contained in them, but to promote easy fusion of the material worked. Where the charge is too fine an addition of slag lumps can open it up and allow a free passage for the air blast to enter. Besides assisting in melting the ore, lumps of slag allow the charges to be worked much more rapidly. Instead of adding more lime or sand, as the case may be, a slag rich in either can be substituted. There is always some foul slag produced even in the best worked furnaces.

A slag having once been melted is much easier to re-melt than unfused material of similar composition. Another advantage is that by effecting rapid melting, less fuel is required to work succeeding charges. That is to say, slag takes the place of fuel within certain limits. If the point is exceeded, however, extra fuel is required to melt even the most fusible slags. A properly made slag should have a low formation point, and be very highly fluid when molten. A viscous slag of high specific gravity is undesirable, as it is able to uphold the metal, even although the temperature is raised. When the composition has not been kept properly under control, slag is known to stick in the furnace and give much trouble before it can be removed. Generally speaking, basic slags are more perfectly fluid than siliceous slags, and are most commonly used in blast furnace work.

The presence of zinc and magnesia tends to increase the viscosity and produce a kind of pastiness, which is not evident when they are absent. Magnesia does not at the same time increase the melting point, and is only added when barytic ores are smelted, since it keeps the specific gravity low without decreasing the fluidity. Zinc oxide principally goes into the slag when present in a lead ore, forming silicates with iron and baryta, which are comparatively easily fused. Although possessing a low melting point, these slags all show the same pastiness as when magnesia is present. When much zinc is present the layers become so thick and pasty that there is difficulty in removing from the matte.

Action of Lime

The principal advantage gained by the addition of lime is that the specific gravity is decreased and the specific heat increased. When much lime is used, the slag separates out more readily than when much iron is present, and also does not chill so quickly. A disadvantage which must not be overlooked is that this constituent requires the addition of more fuel. Within certain limits, lime lowers the melting point of ferruginous slags without increasing their viscosity. If lime is added to already formed slag at a high temperature, it is capable of discharging small percentages of oxides of lead and copper, and leaving a clean slag.

Lime is usually charged in the form of limestone, since burnt lime absorbs carbon dioxide from the furnace gases and is converted to carbonate. The presence of silica detracts from the value of the limestone since it forms slag unnecessarily. Magnesia is an objectionable impurity. Although only a little lime was charged in earlier practice, it is usual nowadays to add a large proportion of limestone in preference to iron flux, since not only is the price of the latter higher, but the cost of the roasting is greater. Combined lead in the slags is decreased by the presence of lime, and the low specific gravity allows shots of lead to be dropped out more effectively than when iron alone is employed. The limit for lime addition should be about 30 per cent., but when zinc is present much less is advisable, according to the nature of the ore.

Iron Ore

When iron ore contains lead it can be advantageously used both as a flux and for the recovery of the latter metal. Difficulty is experienced with many iron ores which are rich in silica and form unnecessary slag, but as a base they can be used without much fear of trouble. As a rule most difficulties encountered in working different charges can be overcome by making an increase in the iron ore content. Pure iron ore is probably the most generally preferred flux, but its high cost prevents it from being more extensively employed. Mill scale and puddle cinder are also too expensive to be used in large quantities.

With the exception of difficulties with zinc, most of the troubles experienced with blast furnaces are due to an insufficiency of iron. Little difficulty will be experienced when too great an excess of iron has been charged. By continuing to conduct analytical tests on all slags produced by different charges, a smelter is enabled to see at a glance what changes have occurred. The effect of altering the fluxes will soon be seen on the slags, and any deficiency quickly made up. Latterly the microscope has been employed for rapidly determining the amount of metal contained in slags in some of the more up-to-date works, with varying success.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Iron and Steel Institute Papers

THE Iron and Steel Institute is to be congratulated on the broad general interest that attaches to the papers presented at the annual meeting, held on Thursday and Friday this week. The programme contained a far higher proportion of papers dealing with the things that really matter than usual. On the other hand it was terribly overloaded, and the impossibility of doing adequate justice to the papers in a two-day meeting with only some ten working hours available is more manifest than ever. There were seventeen papers, and a Presidential Address which in itself was reasonably short, besides other matter which amounted, in all, to over 620 pages of text, *plus* innumerable tables, diagrams, and illustrations. Not only had this enormous amount of literature to be "presented," either nominally, or actually, at the meeting, but to be discussed as well—either verbally or by correspondence—that is, from the author's point of view, the main object in writing a paper at all. One shudders sympathetically to think of the printers' bill, of the ultimate size of the journal in which the papers and discussions will eventually find permanent record, and the other incidental expenses of a volume of "proceedings" which will embody these and the usual abstracts and other matter. However, it is something to the good that the average standard of the papers should have been so high.

A Much Needed Provision

IN circumstances such as the above it is almost imperative that each paper should either begin or conclude with a brief and carefully written summary. It is a deterrent task to have to wade through a paper to find out what are the salient facts or theories with which it deals. Nearly 50 per cent. of the papers had nothing of this nature to guide the reader. On the other hand, the two papers by Sir Robert Hadfield were provided with a workmanlike synopsis of contents, and one of them with a summary as well: the other was not of a kind to need a summary, its scope being adequately conveyed in the title. This is as it should be. The late Dr. Stead was a great stickler for a summary or abstract. The Institute of Metals has always recognised the necessity and adequately provided for it. The new president of the Iron and Steel Institute, Mr. Frank Harbord, C.B.E., has had considerable experience in literary matters, and has acted for some years as chairman of the Institute's Publication Committee. It would be generally appreciated if the provision of a list of contents, a summary, or an abstract were made a *sine qua non* to be complied with by every contributor of a paper to its proceedings. It would be a great boon to the busy worker, and, ultimately, a great advantage to an author of a paper himself, if only in helping him to express himself with lucid brevity. It might even be desirable in some cases for the papers to be printed in abstract only, the full manuscript being deposited in the Institute library for consultation by those desirous of ascertaining the data upon which the author's conclusions were based.

The Metal Manganese

As to the papers themselves, the two with the most permanent interest were those by Sir Robert Hadfield, on manganese and ferromanganese, and on the low carbon alloys of iron and manganese respectively. Sir Robert is the world's leading authority on the subject of manganese, and his paper "The Metal Manganese and its Properties: also the Production of Ferromanganese and its History" is a most valuable contribution to the literature of this important metal. Manganese is attracting an enormous amount of attention of late. The Spring Meeting of the American Institute of Mining and Metallurgical Engineers deemed the manganese question of sufficient importance to arrange for a symposium of papers upon it, to which Sir Robert contributed not the least interesting. There is, apparently, enough manganese ore in the world to render anxiety as to supplies in normal times superfluous. To the deposits in India, in Georgia, in West Africa and in Brazil have to be added the enormous resources of South Africa, where extensive deposits of high grade ore have recently been discovered at Postmasburg. But there is no guarantee that normal times can be relied upon, explicitly, to continue. The supplies, however abundant, are scattered, and far away from the great iron-making countries to whom manganese is absolutely essential for the manufacture of steel. During the war acute shortages were experienced; the dislocation of transport facilities might, at any time, lead to the breakdown of the steel industry. In America this contingency has aroused serious apprehensions. In our own country it would be no less disastrous.

Creating an Ore Reserve

SIR ROBERT HADFIELD has done his best to bring these facts to the notice of those concerned. He quotes the proposals made in America by a committee appointed to consider the whole question of securing adequate mineral supplies. Those proposals embody recommendations comprising the building up of a huge manganese ore reserve—600,000 tons is spoken of—in America. The British Empire possesses—apart from the Postmasburg deposits—something like 44 per cent. of the world's manganese ore reserves, but in the event of communications being interrupted, Great Britain itself might, metallurgically speaking, be reduced to comparative impotence owing to failure of supplies. These aspects of the problem are worthy of attention from all who realise what the facts imply, and we ought to be grateful to Sir Robert for emphasising their importance. His other paper continues the researches on iron-manganese alloys with which his name is so honourably associated. They were undertaken with the object of ascertaining the influence of manganese on iron in the absence of the disturbing influence of carbon. They bring out the striking fact that in the absence of carbon it is impossible to develop in iron-manganese alloys the valuable properties displayed by manganese steel. Indeed, as Sir Robert points out, had carbon-free manganese been available at the time he was making the classical experiments which resulted in his great invention of manganese steel, and been used instead of the carbon-contaminated ferromanganese he actually employed, manganese steel might never have been discovered.

Continental Blast Furnace Practice

ONE of the most interesting papers read at the Iron and Steel Institute meeting was by Professor J. Seigle, of Nancy, on metallurgical practice in gas utilisation in the East of France. A perusal of this paper must have brought relief to the hearts of many British blast furnace managers. The East of France—the Lorraine district, in which the famous Minette ores of Briey occur—is the chief and most formidable competitor in Europe of the British iron and steel industries. The plant and equipment of the French works, and the works of German origin in this district, have often been held up to manufacturers in this country as the last word in efficiency and super-blast-furnace practice. It is possible to glean from Professor Seigle's interesting paper more than, perhaps, he intended to divulge. Beyond a few hints as to gas engine practice on waste gases there is nothing so very wonderful in the practice revealed—nothing but what can be equalled and excelled in the best British blast-furnace practice. There are plenty of works in our own country where the average iron content of the burden is less than that of blast-furnaces working on the ores of Lorraine, and where the average coke consumption compares very favourably indeed with that given in Professor Seigle's paper, which is for 1925 25 cwt. per ton of pig. The general efficiency of power production, even when using gas-driven engines, is lower, too, than we have been taught to believe.

Synthetic Hematite

THERE are some interesting points in Professor Seigle's paper, not the least being the practice of making hematite pig iron in a basic converter. The process employed is novel and ingenious. Ordinary phosphoric (basic) pig from local ores is dephosphorised in the converter in the ordinary way, and the molten metal recarburised either in the ladle or in the converter, wood, charcoal, or anthracite being used for the purpose. "Ferro," thermite, and other additions are made, the former to add the desired silicon and manganese, and the latter to cause a liberation of heat—which suggests that no further

blowing is risked to mix the contents, which is reasonable enough. The carbon can be raised to about 3·5 per cent. Presumably white hematite is the result, although this is not stated. It would be interesting to know how much—if any—alumina finds its way into the pig, and whether, if much be present, any trouble is experienced with the—presumably—acid steel made from this curious synthetic hematite. It is also interesting to learn that electrostatic purification of the blast-furnace dust is about to be introduced in the Lorraine district for the first time, and that neither dry blast nor enriched blast is being used at any of the works.

Alumina Inclusions in Steel

THE reference to the use of thermite in the synthetic practice of making hematite is of special interest in view of recent investigations as to the part played by aluminium in steel practice generally. It is beginning to be suspect. Certain most interesting aspects of the subject are discussed in the paper by Mr. E. A. Atkins on "The Drawing of Steel Wire and its Relation to Qualities of Steel," of which it is not too much to say that it is from every point of view an ideal paper. It is essentially practical, well written and illuminating. The only adverse criticism which can be made is that it has no summary. The short paragraph at the end entitled "Object of the Paper" does not in any way adequately serve to bring out the important facts it contains. The most interesting of all is the specky character which may be imparted to steel by apparently the presence of alumina inclusions. The evidence of the existence of hard crystals in the steel and of their highly injurious effect, not only in the steel wire, but on the wire drawers' plate, is very convincing; that they are some form of corundum, or very hard alumina crystals, almost equally so. "Hard spots" occur in all grades of material, and cause infinite trouble in the machine shop and elsewhere. It may well be that Mr. Atkins has discovered one at least of their causes, and so shown the way to a remedy. Aluminium for stilling steel may, apparently, be the source of the trouble.

Corrosion

THE question of the phenomena attending corrosion, and of the best methods of prevention and protection, offer such a wide field for discussion that it is as well for the chemist and metallurgist to have before him the views of as many authorities as possible. Dr. Frank N. Speller, director of the metallurgical department of the National Tube Co. (of America) has written a book on *Corrosion: Causes and Prevention: An Engineering Problem* (published by the McGraw-Hill Book Co., Ltd., of 6 and 8, Bouverie Street, London, pp. 621, price 30s.), which, presenting as it does an authoritative American view of the subject, deserves careful study. "It will be seen from a study of the various controlling factors," states the author's preface, "that those which act external to the metal afford a natural and logical basis of classification of the various types of corrosion. . . . In addition to the available information from the literature, data have been included from the experience of the author and those with whom he has been associated in the study of corrosion during the past twenty years." The book is intended to combine the functions of a work of reference for those interested in corrosion and of a handbook for those desiring a practical knowledge of developments in the prevention of corrosion. The subject-matter has been written with particular reference to the ferrous metals.

In the first part of the book general principles are discussed. There are chapters, among others, discussing the nature, mechanism, and theories of corrosion; the influence of methods of manufacture and treatment (discussing the methods of manufacture and fabrication of iron and steel as these may affect corrosion resistance); influence of internal factors—composition (the influence of various metallic and non-metallic elements on the corrodibility of iron and steel, and an account of ferrous alloys—containing nickel, chromium, etc.—resistant to corrosion); the influence of external factors (classification of types of corrosion; the transfer of dissolved oxygen to the surface; the effects of other gases, acids, alkalies, salts, etc.; localisation of corrosion, etc.); principles and methods of cor osion testing; and a valuable account, 40 pages in length, of the relative corrosion of ferrous metals, including tests made in the laboratory and in service, and conclusions on the relative durability of wrought iron, steel, and cast iron.

Part II deals with preventive measures, including the prevention of corrosion in the atmosphere (wherein are discussed, among other matters, non-metallic and metallic protective coatings); the prevention of corrosion under water (including an account of artificial and natural protective coatings, and the application of water treatment to water supply systems, condensers and brine in refrigeration); the prevention of corrosion in closed water systems by removal of dissolved gases; prevention of corrosion in high pressure steam plants—boiler water treatment; prevention of corrosion in steam and hot water heating systems; chemical corrosion (giving an account of the subject leading to the question of the selection of the best material for a definite purpose and a discussion of specific materials, both metallic and non-metallic, for use in chemical processes); the prevention of corrosion underground; and stray-current electrolysis. The book closes with a classified bibliography of selected references on the corrosion of ferrous metals, and an appendix dealing with determination of p_H values, the calculation of corrosion as inches penetration per year, the Von Heyer marble test, and a very useful list of materials of construction used in chemical operations, in which is given an alphabetical list of various chemicals and the materials (including special ones for special portions of plant) for the necessary manufacturing plant.

As will be seen from the foregoing, Dr. Speller has succeeded in bringing a great deal of order into what usually appears as a heterogeneous subject, and the book should be a real acquisition to chemists, engineers, architects, and others to whom corrosion is a perennial problem.

The James Forrest Lecture

ON Tuesday, at the Institution of Civil Engineers, London, Professor H. C. H. Carpenter, F.R.S., delivered the thirty-third James Forrest Lecture of the Institution, taking as his subject, "Some Recent Services of Metallurgy to Engineering." Professor Carpenter pointed out that it was twenty-one years since Sir Robert Hadfield delivered the last James Forrest lecture in which metallurgy constituted the main subject, and that it would seem convenient, therefore, to deal with the progress made since that date. The field covered by the lecture was so wide (the printed account filling 39 pages) that it is impossible in the space available to deal with it at length. Some idea of the breadth of the treatment may be obtained from the summary which was given at the beginning of the lecture.

Main Points of the Lecture

IN this summary, Professor Carpenter gave the following as the main aspects of metallurgy which he had decided to consider:

(1) Ore treatment, in which the outstanding advances had been flotation concentration, applicable principally to zinc, lead, copper, and silver; extraction, development of reverberatory practice, with especial reference to copper; and hydrometallurgy, with especial reference to copper and zinc.

(2) Refining of crude metal, in which the outstanding advance was the electric refining of steel.

(3) Manufacture, in which the outstanding advance was the development of the equilibrium diagram, which was indispensable to scientific manufacture. This was illustrated by reference to the iron-carbon diagram.

(4) The foundry, in which the outstanding advance was pearlite cast iron.

(5) Mechanical and heat treatment, in which the outstanding advance was the Sandberg process, and its application to steel tyres and rails.

(6) New metals and alloys, in which the outstanding advances were aluminium and duralumin, tool steel and rapid cutting tools, nickel chromium steels and their wide uses, and, in cables, "mumetal."

(7) The preservation of metals, much scientific work having been done on the causes and prevention of corrosion. Stainless steels and the anodic protection of aluminium alloys were specially mentioned.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

CONDITIONS in the iron and steel trade during the past month have been largely a repetition of those prevailing in the preceding month. There is no improvement. Most of the works are still fairly busy, but there is a very marked reduction in the volume of orders on the books, and the two chief inducements for the placing of orders, lower prices and quicker deliveries, are very much in evidence. The Easter holidays have naturally interfered with business, but those who expected to see an improvement following the holidays are disappointed.

The Position of Trade

There have been several well-meaning attempts in the Press to persuade the public generally that trade is better and that good trade may be expected, but one finds that all such arguments are based on the abnormal activity which followed the end of the coal strike, and therefore they are not only useless but actually misleading. It is only necessary to attend any of the iron and steel exchanges to be convinced of the unsatisfactory position of the trade. It is possible to keep going for a time by living on one's savings, but unless there is new income the last state is worse than the first. In a way that is what the steel works have been doing for the last few months; they have been merrily active in working off the accumulations of orders, but it is the absence of new business which is causing alarm to those who are responsible for the carrying on of the industry. This was pointed out last month, and the position is now even more acute. There seems to be a deadlock between buyers and sellers. Consumers do not appear to be interested in anything beyond their day-to-day requirements.

The Birmingham Meeting

The Birmingham quarterly meeting was awaited with some interest but not much hope, as it is a fairly reliable barometer of the trade, but there was no indication at that meeting of any improvement; in fact, the effect of the meeting was to confirm the buyers in their attitude. There may be some consolation in the thought that stocks are getting used up and that users will then be forced into the market, but it is very slender comfort. Speaking from the consumers' point of view, it has been good policy not to make forward contracts, because the whole tendency of prices has been, and still is, downwards. The steel makers themselves have no confidence in the future; their action in connection with the railway contracts proves that. Lower prices were quoted for long period contracts than for short; surely a confession of pessimism and uncertainty as to the future.

It is no use being surprised or disappointed because new business is lacking. Lower prices are expected by the consumers, lower prices are foreshadowed by the makers, and so business is more or less at a standstill. In the normal course of things contracts were made according to the individual requirements of the users, and the upward and downward movement of prices, within comparatively narrow limits, showed such a practice to be quite safe over a period. But normal conditions have been unknown since the war. It has been one continuous move downwards practically up to the commencement of the coal strike. Then an advance was necessitated by the force of circumstances, but the long experience of the past prevented the possibility of this advance being recognised as legitimate or durable, and the attitude towards it has been that of grudging compliance only so long as it could not be evaded. Now the time has come when the lack of new work is forcing the makers to give way.

This point is continually being brought out in the speeches of industrial leaders when addressing the shareholders of the steel-making companies. It was stated quite recently at one of these meetings that until the inefficient plants were closed down for good there would be no real improvement in the steel trade. By taking a share of the limited amount of work available, they reduce the output of the efficient works, and so the cost of production is increased and adverse results are shown. It is not a question of selling price in relation to actual cost. The out-of-date plants are just as ready to cut the price as the modern ones, and in the state of trade, as we are now finding it, this readiness is all the more noticeable. Nevertheless the truth is there. The inefficient works will have to close down and leave the orders to be executed by those which are able to do so economically. Unfortunately that step will not be taken voluntarily; it will ultimately be forced upon the unwilling.

Competition

Foreign competition is generally held up as the bogy of the iron and steel trade, but the internal competition is even more intense, and so often it is unnecessary. How many instances there are of work being taken at a price less than the consumer was willing to pay, simply because of this internal competition. The height of folly was reached when two branches of one large undertaking discovered that they had been competing against each other for a certain contract with the result that the work was executed by one branch at a price several shillings a ton less than would have been paid had there been co-operation instead of antagonism between the two branches. It is this kind of thing which makes it difficult to see how the British steel makers can become sufficiently united to make practical politics of the proposal to join the European cartel.

Marking of Imported Steel

A good deal of interest has been aroused by the application made by the National Federation of Iron and Steel Manufacturers, under the Merchandise Marks Act, 1926, for certain classes of imported iron and steel to be marked with its origin. It is an important step, and if the application succeeds it may have a far-reaching effect on the iron and steel trade of this country. The purpose of the application is to ensure that those who desire British materials will know whether they are getting them or not. Anything which tends to encourage the use of British steel in preference to foreign will be welcomed by the general body of steel makers. There is no doubt that a large quantity of foreign steel is sold here, both in the imported and in the manufactured state, as British steel, to the grave disadvantage of the home producers, and the application is designed to put a stop to this practice. Naturally there is opposition to the application on the part of those who gain an advantage from the use of foreign steel, but the onus is on the objectors to prove their case. The inquiry is now proceeding.

The Coke Situation

There has been a further development in the coke situation since last month. For a time the makers were firm in their demand for 22s. at the ovens, and many contracts were placed at this price. To some extent this high price was due to the action of one or two large consumers, who in their anxiety to get supplies made offers of large tonnages at a price round about this figure. Some of the blast furnace owners, who were in a position to do so, have steadily refused to pay the advance, with the result that considerable quantities of coke have been thrown on the market. Supplies are now easier and the price has weakened. Makers are still to be found who ask 21s. and 22s., but there is no difficulty in buying at 20s., and that price will not hold long. Coal is weaker, as the supply far exceeds the demand. By the middle of the year we should see pre-strike prices in force.

Prices generally have fallen during the month. Pig iron is at least 2s. 6d. per ton cheaper, and hematite has been reduced 2s. There is still a tendency on the part of some pig iron makers to hold out for a better price, but if they are wise they will book what they can at the present figure, as the next move is bound to be downwards. Steel plates and bars are also cheaper, although there have been no official reductions. The Association prices are readily underquoted when the inquiry is of any magnitude.

There were 12 more blast furnaces at work at the end of March than at the beginning, the number being 178, as compared with 147 at the end of April, 1926. The production of pig iron in March was 671,800 tons, which is 100,000 tons more than in February. The output of steel amounted to 949,600 tons, compared with 826,800 tons in February.

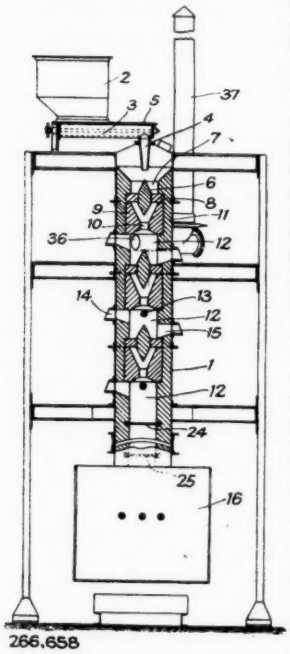
Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Electric Furnace Methods

ACCORDING to a patent by D. Crôese, Finsbury House, Blomfield Street, London, metals or alloys are extracted from finely divided ores, such as iron-sand, by removing impurities, preheating, and then allowing to fall by gravity through a succession of arc chambers provided with means for breaking up the stream of falling material and directing it on to the next arc. In a form of furnace described the iron-sand and necessary reducing agent are fed from a hopper 2 by a conveyor 3 to the top of the furnace, which comprises a series of chambers 12, provided with electrodes 13. Between each pair of chambers is provided a double conical baffle 6, of graphite or other material, supported on arms 8 projecting from the sides of the furnace; below each baffle is a constriction 10. The reduced molten material is collected in a crucible 16, and the molten metal tapped off. The crucible may also be provided with heating electrodes so that any desired final treatment may be imparted to the material therein. The waste gases from the furnace are in part used in the preheating of the material in the uppermost chamber 7. See patent No. 266,658, having the date August 27, 1925.

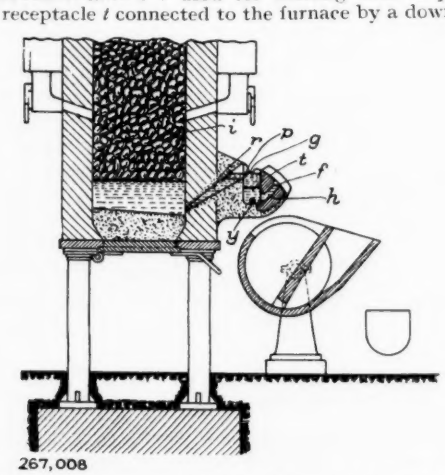


266,658

According to a patent by E. C. R. Marks, London, from the New Process Castings Co., New Jersey, U.S.A., the molten iron from a blast furnace is discharged successively into a number of electric furnaces in which the final adjustment of composition and temperature is effected in known manner. The electric furnaces are preferably mounted upon a turntable so that they may be successively brought into engagement with a set of electrodes. See Patent No. 267,590, having the date December 15, 1925.

Iron and Steel

A CUPOLA-FURNACE *i* used for melting iron is provided with a receptacle *t* connected to the furnace by a downwardly inclined passage *r*; the receptacle *t* has a tapping off gutter *g* for the slag and an ascending overflow passage *h* for the iron. The point *p* is at such a level that the column of iron in *r* is supported by the slag, iron, and air pressure in the cupola. As the quantity of iron in the latter increases the iron is forced out of *r* and is separated from the slag in the receptacle *t* without any interference from the pressure of the air blast. See Patent No. 267,008, by W. Dietrich, Dortmund, Germany, having the date September 4, 1926.



267,008

A. E. G. T. von Vegesack, of Munkfors Bruk, Sweden, describes a stainless steel suitable for edge-tools containing 0·7 to 1·1 per cent. of carbon, 10 to 16 per cent. of chromium, and 0·75 to 2·0 per cent. manganese. With tools made from this steel the highest cutting efficiency is obtained by air hardening in the usual way, and then heating to 400° to 500° C. for a time, though usually such treatment causes a steel to lose its hardness. The steel is particularly resistant to corrosion, even when the carbon content is high. See Patent No. 268,616, having the date July 24, 1926.

According to P. R. Kuehnrich, of Eccleshall, Sheffield, similar steels, namely, those containing 10 to 20 per cent. of chromium and 1 to 1·7 per cent. of carbon, are hardened and given rustless qualities by heating to about 1,150° C. out of contact with air, cooling in air, heating to 650° to 750° C., cooling in air again and finally heating to 1,020° C. and quenching. Stainless properties cannot be given to such steels by the usual heat treatment. See Patent No. 267,687, having the date February 19, 1926.

Reducing Ores

IN reducing ores, particularly iron ores, the mixture of ore and reducing agent is fed continuously in a thin flat stream down retorts 2 which are heated by hot gases passing in zigzag fashion through flues 3. The hot gases are produced by combustion of fuel at a burner 8 (Fig. 2) supplied with air preheated by passage through flues 5 heated by the passage of the reduced ore. The heating gases pass away by the main 10 and gases from the retorts by the main 21 after they have preheated the ore in the upper parts of the retorts. The reduced ore passes by the valves 14 into the hoppers 17. See Patent Application 266,289, having the International Convention date February 17, 1926.

FIG. 1.

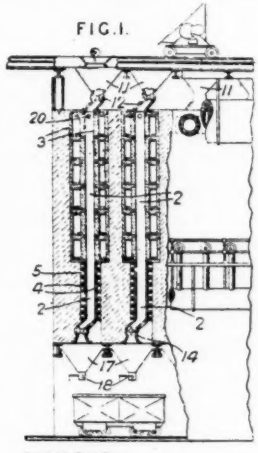
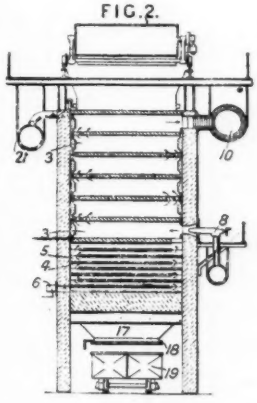


FIG. 2.



266,289

Death of Young Metallurgist

MR. W. T. COOK, B.Sc., A.I.C., of Cardiff, died on Tuesday, April 19, as the result of injuries received in a motor-cycling accident. Mr. Cook, who was only 22 years of age, entered the University College of South Wales and Monmouthshire in October, 1921, and three years later obtained an honours degree in chemistry and the applied science degree in metallurgy. After taking his degree Mr. Cook was appointed metallurgist and general chemist to the Excelsior Wire Rope Co., Ltd., Cardiff. In this capacity he was developing the theory of the production of rope wire, devising new tests for wire and improving old tests. His spare time he devoted to research at the metallurgical laboratories of University College, Cardiff. He assisted in an investigation of a new series of alloys having magnesium as the chief metal. He was the joint author of a paper on this subject published by the Institute of Metals last September.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ANALYSIS.—A new apparatus for the determination of sulphur in iron. W. Herwig. *Chem.-Zeit.*, April 13, p. 275 (in German).

Is there a safe method for the determination of silicon dioxide in the presence of silicon in the analysis of aluminium? Brettner. *Chem.-Zeit.*, April 6, p. 261 (in German).

A method for the detection of sulphur in steel grindings. H. J. van Royen and E. Ammermann. *Stahl u. Eisen*, April 14, pp. 631-632 (in German).

CRYSTALS, ETC.—The formation of twin metallic crystals, G. D. Preston. *Nature*, April 23, pp. 600–601.

The tetragonal structure of carbon steel. N. Seljakow, J. Kurdumov, and N. Goodtzow. *Nature*, April 2, p. 494.

ELECTRIC WELDING.—Studies on electric welding. L. J. Weber. *Trans. Amer. Soc. Steel Treating*, March, pp. 425–459. The effect of various gases on the metal deposited in electric welding as well as the effect of the arc on the gases has been studied. It is shown that abnormal carburising steels were produced when the steel was deposited in an atmosphere of carbon dioxide, carbon monoxide, nitrogen, and air, while normal carburising steel was produced when the weld was made in an atmosphere of helium. The carbon dioxide was decomposed to carbon monoxide and oxygen, the oxygen causing oxidation of some of the iron.

ELECTROMETALLURGY.—The electric smelting of tin ores. F. Freude. *Cont. Met. Chem. Eng.*, March, pp. 70–72 (in English).

GENERAL.—Aluminium as a material in chemical industry. H. Röhrig. *Chem.-Zeit.*, March 30, pp. 237–238 (in German).

The compounds Fe_3S_4, Co_3S_4, and Ni_3S_4, and their structure. W. F. de Jong and H. W. V. Willems. *Z. anorg. u. allg. Chem.*, April 5, pp. 311–315 (in German).

The conditions of use of refractory materials in the Martin furnace. B. M. Larsen, F. W. Schroeder, E. N. Buner and J. W. Campbell. *Rev. Métallurgie*, March, pp. 146–158 (in French).

Sand moulding practice. J. D. Nicholson. *Foundry Trade J.*, April 21, pp. 339–342.

The production and uses of Ni-Cr-Fe and Co-Cr-Fe castings. J. Kayser. *Foundry Trade J.*, April 28, pp. 351–354.

IRON.—The changes of solubility and hardness of twisted and bent iron. B. Garre. *Z. anorg. u. allg. Chem.*, April 5, pp. 305–308 (in German).

The oxygen in pig iron and cast iron. P. Oberhoffer and E. Piwowarsky. *Stahl u. Eisen*, March 31, pp. 521–533 (in German).

PHASE RULE.—The ternary system lead-antimony-arsenic. E. Abel and O. Redlich. *Z. anorg. u. allg. Chem.*, April 5, pp. 221–227 (in German).

Ternary systems with iron and carbon. 1. The phases "$Fe_3C.Cr_3C$" and $Cr_{10}C_6Fe_3$, physical "residual analysis." F. Sauerwald, H. Neudecker, and J. Rudolph. *Z. anorg. u. allg. Chem.*, April 5, pp. 316–320 (in German).

STEEL.—Note on chromium and cobalt steels. F. M. Ostroga. *Rev. Métallurgie*, March, pp. 135–145 (in French).

The decomposition of the austenitic structure in steels. II. The decomposition of austenite in liquid oxygen. O. E. Harder and R. L. Dowdell. *Trans. Amer. Soc. Steel Treating*, March, pp. 391–398. Specimens of various steels were immersed in liquid oxygen, and the progress of the decomposition followed by changes in hardness, microstructure, and specific gravity. A general correlation of these changes has been found. A marked difference in the stability of the austenitic structure at low temperatures is clearly shown. Consideration is given to influence of the stresses at liquid oxygen temperature on the decomposition of the austenite.

On the transformation of retained austenite into martensite by stress. K. Honda and K. Iwase. *Trans. Amer. Soc. Steel Treating*, March, pp. 399–412.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an*—followed by the date of the Summary, but such total may have been reduced.*]

APPLEBY IRON CO., LTD., Frodingham. Registered March 26, £76,500 second mortgage, to Assurance Co.; charged on lands and buildings at Frodingham and Scunthorpe and Appleby, also general charge (subject, etc.). *£1,710,000. November 23, 1926.

ASKEEN COAL AND IRON CO., LTD. Registered April 6, £700 (not ex.) mortgage, to Building Society; charged on Claremount Villa, Campsall Road, Askern. *£640,928. July 19, 1926.

GALLOWAYS, LTD., Manchester, ironfounders. Registered April 5, £40,000 debenture, to Bank; general charge (subject, etc.). *£150,000. December 31, 1926.

INTERNATIONAL ALUMINIUM CO., LTD. (late BAUXITE REFINING CO., LTD.), London, S.W. Registered April 13, £500,000 debenture stock and premium of 5 per cent. (secured by trust deed dated April 4, 1927), present issue £250,000; charged on land and buildings at Hebburn, etc., also general charge. *Nil. December 15, 1926.

PARTINGTON STEEL AND IRON CO., LTD., Irlam. Registered March 16, £300,000 debenture, to Bank; general charge. *£1,171,325. October 13, 1926.

PEARSON AND KNOWLES COAL AND IRON CO., LTD., Warrington. Registered March 25, trust deed dated March 11, 1927, securing £300,000 first debenture stock and a premium of 2½ per cent. (supplemental to trust deed dated February 9, 1922, securing £1,000,000 first debenture stock); charged on hereditaments comprised in schedule to original trust deed, also general charge. *£1,520,000. October 13, 1926.

PHOSPHOR BRONZE CO., LTD. (late NEW PHOSPHOR BRONZE CO., LTD.), London, S.E. Registered April 9, £200,000 debentures; general charge. *Nil. February 2, 1927.

PRESSED STEEL CO. OF GREAT BRITAIN, LTD., Cowley (Oxon). Registered March 29, £200,000 debentures (secured by trust deed dated March 21, 1927); charged on land, buildings and plant, etc., at Cowley and Iffley.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield. Registered March 18, £1,300 and £100 debentures, part of £750,000; general charge, but not including uncalled capital and certain property. *£582,350. October 12, 1926.

TAYLOR BROS. AND CO., LTD., Manchester, iron and steel manufacturers. Registered March 12 (by order on terms), £9,360 and £500 mortgages or charges to Barton-upon-Irwell R.D.C.; charged on land and houses at Davyhulme, except mines and minerals, etc. *£107,142. September 14, 1926.

THOMAS (RICHARD) AND CO., LTD., London, W.C., steel and tinplate makers. Registered March 18, trust deed dated March 11, 1927 (supplemental to trust deed dated February 28, 1922), securing £500,000 further debenture stock in addition to £1,000,000 secured by principal deed; general charge. *£1,483,472 17s. December 31, 1926.

WIGAN COAL AND IRON CO., LTD. Registered March 29, a mortgage and a further charge (supplemental to deed dated March 19, 1926), securing 90 per cent. (not ex.), of valuation of certain houses, etc., to Worksop U.D.C.; charged on said houses, etc. *£24,563 6s. 8d. March 4, 1927.

Satisfactions

CAMBRIAN ELECTROLYTIC ZINC CO., LTD., London, E.C. Satisfaction registered March 24, £10,000, registered July 19, 1923, and March 6, 1925.

FIRTH-BREARLEY STAINLESS STEEL SYNDICATE, LTD., Sheffield. Satisfaction registered March 16, £10,000, registered September 15, 1926.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Distortion and Growth in Cast Iron on Repeated Heating

By J. G. Hurst

In the following article the growth of cast iron under repeated conditions of heating and cooling is discussed, and compared with the "spalling" phenomenon exhibited by refractory materials; and suggestions are made as regards points worthy of investigation.

THE phenomenon of growth experienced by grey cast iron when subjected to conditions of repeated heating and cooling is now familiar to most engineers and other users of cast iron. Attention was first directed to this phenomenon by the experiments of Alexander Outerbridge in America in 1904, and it was extensively and exhaustively investigated in this country by Professors Carpenter and Rugan in 1909 and 1910. The explanation of this phenomenon of growth derived from Carpenter and Rugan's experiments is of a purely chemical nature, and the growth is ascribed to the internal oxidation of certain of the constituents of the cast iron. The oxidising gases to which the cast iron is exposed at the high temperature conditions are able to penetrate into the interior of the cast iron by way of the graphite plates. The principal constituents oxidised are the silicon, iron, and carbon, and the permanent expansion in volume experienced by the oxidation products is responsible for the growth phenomenon.

In considering this subject further it is necessary to define the growth phenomenon more particularly. In industrial cases in which growth or permanent volume expansion occurs, the cast iron is subjected to a wide variety of conditions of temperature, reversals of temperature, and character of the gaseous atmosphere. All these conditions influence to a varying extent the oxidation of the constituents and the decomposition of the combined carbon in the cast iron, and for this reason will exert a corresponding influence on the extent of the growth.

For the time being the writer prefers to apply the term "growth phenomenon" to those cases of volume changes which occur at comparatively high temperatures—above 600° C.—and which usually result in the final disintegration of the cast iron. In adopting this course a distinction is being drawn between volume changes at high temperatures and those at low temperatures such as have been extensively investigated by Donaldson. This distinction might finally be shown to be purely arbitrary, but in any case the distinction does appear to have been tacitly inferred by Carpenter and Rugan in their extended investigations.

Insufficiency of Chemical Explanation

The complete explanation of the growth phenomenon on purely chemical grounds has always been regarded as insufficient, and the influence of purely physical or mechanical conditions was raised by Saniter in the discussion which ensued in connection with Carpenter and Rugan's work. Saniter discussed the question as to why it was necessary to heat and cool the samples to obtain the maximum increases in volume, and suggested that this was in some way connected with the thermal expansion. Further attention has been called to this aspect of the problem by various Japanese investigators during recent years, and while there is no doubt as to the extent and importance of the chemical influences, the complete and final conception of the growth phenomenon will have to take into consideration the influence of the thermal expansion factor.

In order to consider this thermal expansion factor still further it is advisable to revise the above definition of the growth phenomenon by omitting the chemical factors. The phenomenon can be considered on the basis of a simplified definition that growth can be regarded as the failure of the material to withstand the stresses set up by the fluctuations in temperature, without disintegration. It is of interest to recapitulate the manner in which these stresses are set up within the material. If we imagine a bar of cast iron subjected to a heating process, and we imagine this bar to be built up of a series of laminæ of minute thickness, the outer layers become heated to a particular temperature before the inner layers. Until uniformity of temperature is established and the bar is said to be evenly heated a temperature gradient exists across the section of the bar. On cooling down, exactly the reverse of this state of affairs occurs, and a temperature gradient exists from the centre of the bar to the outside layers until the bar becomes uniformly cool. The continued heating and cooling of the bar results in the continued reversal of the temperature gradient across the section of the material. The existence of temperature gradients implies the existence of expansion gradients, which in their turn imply the existence of stress gradients. The stress gradients set up across the section of the material are being constantly reversed in direction in the case of bars which are being heated and cooled, and it is the failure of the material to withstand these stresses which results in the growth phenomenon.

Analogous Phenomena in Refractory Materials

Considerable support of an experimental nature is given to this view as to the cause of growth by the experiments of Durand, who found that the extent of growth, in addition to being proportional to the silicon content, was also proportional to the rate of heating. These experiments were carried out over a range of temperature of 600° to 900° C., and the measurements were made by means of a dilatometer. It was found that growth varied directly as the silicon content and inversely as the rate of heating. The consideration of the phenomenon of growth from this point of view is striking in its analogy with the phenomenon of the disintegration of refractory materials, particularly firebricks, when exposed to high temperature conditions. This tendency to disintegrate in refractory materials exposed to heat conditions is referred to as the "spalling" tendency, and has been investigated by Le Chatelier, Winckelmann and Schott, Norton, Green and Dale, and others. Norton and Winckelmann and Schott have been able to relate this spalling tendency in refractory bricks to certain fundamental physical properties of the material. Of the factors to be taken into consideration in determining the spalling tendency the stress conditions which produce failure or rupture of the material are most important.

Norton, in his consideration of this subject, introduced a factor of maximum shearing strain, which is defined as the maximum distance a plane in the material can be moved parallel to another plane without rupture. In his formula the spalling tendency is related to this maximum shearing strain in the following manner :—

$$S = \frac{E\, s_1}{F_1 \sqrt{h^2}}$$

where :—

S = The spalling tendency.
E = The coefficient of expansion of the material.
F = The maximum shearing strain.
h^2 = The thermal diffusivity.
s_1 = A "size" factor.

The formula propounded by Winckelmann and Schott is

somewhat different, as follows, where S and E and h^2 have the same significance as in the Norton formula :—

$$S=\frac{E}{\frac{T}{M}\sqrt{h^2}}$$

where T and M are the tensile strength and the modulus of elasticity. Both these formulæ indicate that the spalling tendency is directly proportional to the coefficient of expansion, and inversely proportional to a strength factor and the thermal diffusivity. The thermal diffusivity factor is defined by the ratio :—

$$\frac{k}{Cp}=h^2$$

where k=The thermal conductivity.
C=The specific heat.
p=The density.

From mathematical and thermal considerations the present author derives the following formula :—

$$S=\frac{C\,s_1\,E}{\sqrt{h^2\frac{f}{R}}}$$

where C=A constant.
s_1=The size factor.
f=Shearing stress.
R=Coefficient of rigidity.

[NOTE.—In the author's original manuscript the mathematical derivation of the above formula is given in full. It has been omitted from considerations of space.—EDITOR, *C.A.*]

In both the above formula and the Winckelmann-Schott formula the fundamental factors governing the spalling tendency are related to three independently variable physical properties : (1) Temperature diffusivity ; (2) Ultimate shear strength or tensile strength ; and (3) Temperature volume relationship.

Growth in Cast Iron

The striking analogy between the spalling phenomena in refractory materials and the growth phenomenon in cast iron has already been referred to, and it will be remarked at once that the experimental observations of Durand are partially embodied in the above formulæ, indicating, as they do, that the spalling tendency is inversely proportional to the temperature diffusivity.

The only point in which the above formulæ differ is in the use of factors involving the tensile strength and shear strength respectively. The failure or rupture of material subjected to stress, from the point of view of the elastician's analysis, involves the ultimate failure by shearing stresses. Strictly speaking, therefore, the formula embodying the shear strength term is likely to be the more fundamentally correct. From a practical point of view the tensile strength is a property more easily and directly measured, and for this reason the formula involving this tensile strength factor is likely to be of more practical value. It is of very great importance to note that the formula also embodies the elasticity coefficient and indicates that the spalling or growth tendency is inversely proportional to the maximum strength and directly proportional to the modulus of elasticity (or in the case of shear, the modulus of rigidity).

The importance of the elasticity factor cannot be over-emphasised. The tendency to failure of material is directly proportional to the elasticity, and it is highly probable that in a material like cast iron very small changes in the coefficient of elasticity will have considerable influence on the growth tendency. The coefficient of expansion will obviously influence the magnitude of the stresses set up in the material, and for this reason the factors involving this property and the temperature gradient within the material have a perfectly logical place in the formulæ. Naturally under a given set of conditions the temperature gradient will depend upon the size and shape of the material, in addition to the temperature diffusivity. For this reason the inclusion of the size factor becomes necessary. In comparisons made on similar shapes and sizes this factor can obviously be omitted.

In the experimental work on the growth phenomenon in cast iron hitherto, the relationship between this phenomenon and the strength properties has not been closely investigated. In the investigations of volume changes in cast iron at comparatively low temperatures the observation has been recorded by Mellanby that the resistance to various changes at various temperatures by different cast irons is directly proportional to their resistance to wear. Donaldson in his experiments obtains high resistance to permanent volume changes in those irons having the highest tensile strengths at all ranges of temperature. From these observations we have a partial proof of our previous deductions. Whilst resistance to wear is in itself a complicated property and is not easy of mathematical analysis it is certain that it involves both the ultimate strength and elasticity factors. The observation of Mellanby is of considerable importance, and when considered from this point of view lends considerable support to the analogy between the growth phenomenon in cast iron and the spalling tendency in refractories. From these considerations it would appear that a very useful purpose would be served in the further investigations of the growth and permanent volume changes in cast iron with special reference to the strength and elastic properties of the material in addition to the temperature-expansion gradients set up under different conditions of heating.

Manganese in South Africa

Important Developments

"SOUTH AFRICA is on the eve of developments in connection with its manganese deposits that will stagger the country. Before long we shall have the largest manganese mines in the world." This important statement was made by Sir William Hoy when he opened the publicity conference held at Durban recently. What Sir William Hoy evidently had in mind are the enormous deposits of minerals containing this valuable metal (for which there is an increasing world demand) which have been traced for over forty miles near Postmasburg, about 100 miles west of Kimberley. The Union Manganese Co., Ltd., a Johannesburg concern of which Mr. R. B. Saner is chairman, has secured either freehold, or on long leases with option to purchase, a large area of the farms in which this deposit has been located. Mr. Saner recently returned from a trip to Europe, where preliminary negotiations were entered into with representatives of important American steel companies, whereby these companies will work a minimum of 200,000 tons per annum of the ore on a royalty basis. The promoters of the enterprise have agreed with the Railways Administration to defray the cost of constructing a line to connect Postmasburg with the main line, the cost of this construction being estimated at something like £250,000. The Union Government is naturally taking a very keen interest in this project, and allowed Dr. A. L. Hall, of the Government Geological Survey, to furnish the promoters with all the required technical information concerning the manganese deposit, upon which he had previously prepared a detailed report. Samples of the Postmasburg manganese have been tested in Europe and declared by experts to be the best in the world. Dr. Hall estimates that there are well over 24,800,000 tons of the ore available within a depth of 100 ft. on the dip ; and that there are 2,700,000 long tons in sight in the form of residual cappings and along the outcrop of the reef. The Union Manganese Co., Ltd., was registered in February last, with a capital of £12,500 ; the directors are R. B. Saner (chairman), Mr. G. A. E. Becker, Mr. J. Dale Lace, and Captain Shone.

The East London correspondent of the *Johannesburg Star* gives the following additional details : The Union Manganese Co., Ltd., which was formed with a capital of £12,500, has been taken over on a royalty basis by an American company. This latter, with the usual American thoroughness, has placed in the hands of the Union Government a sum of £250,000 for the making of a railway connecting, at Koopmansfontein, the projected railhead of the Barkly West—Winter's Rush construction. The American company is also to undertake to supply all ore required by industries in South Africa before shipping overseas, so that South African requirements for ferro grade ore will be fully met and safeguarded. In well-informed mining circles it is thought that the American company will not for long be content to ship the crude ore, which will mean 60 per cent. of waste tonnage, but that the ore will be treated in South Africa and shipped as spiegeleisen and in other forms.

The State of Beryllium Production

A Recent German Note

The following is translated from an article entitled "Beryllium: A New Material of Technics," by J. Becker, which appeared in the "Zeitschrift für Elektrochemie" for May.

THE significance of the light metals in technics has increased by leaps and bounds. An example of this is the influence of aluminium on the modern development of motor traffic, electrotechnics, and air machine construction. After the age of heavy metals aluminium introduced the period of the reduction of dead weight. In 1900 there were produced in the whole world 7,700 tons of aluminium; in 1924 the world-production amounted to 188,000 tons. This rise of the aluminium industry and of the industries bound up with it is based on a method of preparation (namely, electrolysis in a melt) which was carried out on the large scale for the first time in the eightieth year of the last century. The technique of powerful electric currents, which by the production of great current-strengths first rendered this process possible—for the production of one metric ton of aluminium requires 30,000 K.W.H.—has found further uses by the application of aluminium in its development: an example of cause and effect in technics.

Comparison with Aluminium

In the Periodic System of the elements aluminium has the atomic number 13. If one considers the still lighter elements, it appears that beryllium has hitherto not received much notice. It was first produced in metallic form in 1828 by the chemist Wöhler, who, a year previously, had for the first time produced pure aluminium. However, he obtained beryllium only in small platelets, and subsequently interest was narrowed to the determination of its chemical constants. Only recently were efforts made to produce beryllium in larger quantities by electrolysis in a melt, similarly to aluminium.

The Berlin professors Stock and Goldschmidt, who worked out an electrochemical method for the production of beryllium, found that its industrial utilisation was a possibility. For further investigations the Deutsche Beryllium-Studiengesellschaft (Germany company for investigating beryllium) was formed in 1923, and numbered among its members both the above-mentioned investigators and a series of interested firms, including Siemens and Halske. After the dissolution of this company experiments were continued in the department of electrochemistry of Siemens and Halske, directed by Professor Engelhardt. These experiments have recently led to valuable results. In a small experimental plant 120g. of beryllium are already produced there daily, a quantity which can be increased considerably without difficulty. The metal as produced by the method of Stock and Goldschmidt cost about 200 marks per gram; to-day's price for beryllium for technical purposes is 6 marks per gram. In this connection the quite similar evolution of the price of aluminium may be remembered. Even in 1886, when the electrochemical method for the production of aluminium was already known, the price amounted to 70 marks per kg. When, however, the industrial production of aluminium became established, the price fell rapidly, so that in 1900 it was only 2 marks per kg.

Technical Possibilities

The possibilities of the technical application of beryllium can only be hinted at, for experience teaches that the domain of application increases in the measure in which a material is available. Indications of the technical application are given by the properties of the metal. Pure beryllium is one-third lighter than aluminium; the respective specific gravities are 1·8 and 2·6. The hardness of beryllium is greater than that of glass; the melting point is about 1,285° C. In certain alloys it is extraordinarily malleable, and can be rolled out into thin leaflets. Where especially light membranes are desirable, as for example in electro-acoustical apparatus, such beryllium alloys will win some significance. Beryllium transmits X-rays seventeen times better than does aluminium, so that through this property, in conjunction with its high melting point, it should possess value in X-ray technology. The sources of beryllium in nature are not at the moment very numerous or rich. It occurs as a mineral in combination with various elements. Of these, the richest in beryllium is phenacite (beryllium silicate), which contains up to 45 per cent. of beryllium oxide, but is only found in small quantities. More frequent in occurrence is beryllia. Crude beryl is found in considerable extent in Norway, Spain, and Canada, and to a less degree in South Germany and the Tyrol. It may, however, be assumed, in view of experience gained in the case of tantalum and tungsten, that the sources will increase as the demand for beryllium grows.

Non-Ferrous Metal Research

Annual Report of Association

THE seventh annual report of the British Non-Ferrous Metals Research Association, which has just been issued, describes its work during 1926, which was carried out at various centres. The field covered is wide, as the scope of the Association embraces all the principal non-ferrous metals, such as aluminium, copper, lead, zinc, nickel, etc. The history of engineering shows how closely advance has depended on the improvement of materials, and almost every manufacture or handicraft is capable of progress as the result of a fuller knowledge of the materials it uses. Other countries are keenly alive to the value of scientific research and are striving to attain and surpass our position by work very similar to that carried out by the research associations.

Value of Co-operation

The co-operative system of sharing the costs of industrial research, which is rendered possible by the research association scheme, enables members to secure the full results by individual subscriptions amounting to only one-hundredth to one-thousandth of their cost. The report gives details of the 27 researches which have occupied more than forty scientific investigators during the past year. These include work on the effect of impurities on the properties of copper; atmospheric corrosion of metals; die-casting alloys; gases in copper castings and bronze; properties of lead; special brasses and high tensile copper alloys; silicon-copper alloys; improvement of working properties of zinc; spectroscopic assay of zinc, etc. New and projected researches include, among other things, the work on the electrodeposition of metals; on the galvanising process; and on nickel plating, the latter with the special support and encouragement of the Mond Nickel Co., Ltd.

Sir A. Mond's Belief in University Men

"Highly-trained university men are required for every part of our business activities to-day," said Sir Alfred Mond, M.P., in insisting, on Friday, May 27, at the annual luncheon of the British Non-Ferrous Metals Research Association at the Savoy Hotel, London, on the need for men trained to the needs of the day and having a wide outlook and scientific knowledge. "You have to carry the scientific idea right through all business, otherwise you find a great hiatus between the factory departments and the selling departments. There has been a great change in the relations between manufacturers and their customers in recent years. To-day if a firm wants to progress it can do so only by giving the utmost satisfaction to customers. There is a wide field for research and a definite need for combination. I know in the case of a business with which I am associated that it has only been by combination between our staff and people engaged in the metallurgical industry who supplied us with metals that we have been able to obtain certain special alloys we needed. This combination of user and maker in research makes for the progress of industry and of the world. I had an interesting trip to Germany not long ago and saw some of their magnificent research laboratories. When I compare the amounts we spend on research in this country with what they spend in Germany, I feel ashamed."

Sir Frank Heath, in making a last appearance before retiring from his post as secretary of the Department of Scientific and Industrial Research, urged that research should be looked upon as a form of provision against depreciation. He referred especially to some sections of the metal industry for which the Association had already most valuable results to offer, but where support by the producers has not yet been awakened.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Electroplating Practice

APPLIED science has had markedly valuable results during the last few decades in accelerating and cheapening industrial processes, and enabling mass production to be carried out where only small outputs were once available. There is a tendency to rely too greatly on the cheapening aspects. Applied science is only justified in its results if its products are not only cheaper, but actually better than the empirical methods and hand crafts which it is superseding. Thus, for instance, much research work has been done of late years on the electrodeposition of metals; the rationale of processes are better understood and they are under better control. Deposits can be made as thick as is required, or as the customer is willing to pay for. Unfortunately, too, they can be made as thin as possible, and a thinly coated article looks just as good when it emerges from the bath, as an article with a good, thick, and durable deposit. There is a strong temptation to rest satisfied with a mere wash, the more so as the public craves for cheap work and is not in the position of judging whether the work is good enough, even at the price. Hence, as was stated by more than one speaker at the last meeting of the Electroplaters' and Depositors' Technical Society, there is a tendency, in many small shops, to cut prices by giving only a superficial coat, which, however bright and perfect it may appear to be, will not stand up in service. The public, not being able to appreciate the conditions, and judging the work by the subsequent criterion of wearing quality, is beginning to look upon electroplating with some suspicion, a state of affairs which calls for immediate remedy.

Protecting the Industry

LET it be said, at once, that the leading electroplaters in this country turn out unassailably good work, of perfect finish and of enduring quality. They have their own research departments and these are under the control of experts. Moreover, they have undertaken many investigations to ascertain what thickness of coating confers the maximum protection on the base metal. They have to face the keen competition of the few smaller and less scrupulous electroplaters who have made the converse discovery, namely, the minimum deposit which will cover, without really protecting, the underlying metal. This gives shoddy work, and, in the interests of the industry as a whole, it is being felt that some method should be found, both of protecting it against such unfair competition, and of protecting the buyer himself against the result of his own craving for cheap work which will not last, and is thus far more expensive, even for him, in the long run. The subject was well aired at the meeting referred to, at which the paper more immediately under discussion was one on "Electro Deposits on Iron," by Mr. S. Wernick, M.Sc., which was given at length last week in THE CHEMICAL AGE. Dr. W. H. Vernon, whose splendid work on corrosion is well known to all, presided. Some valuable suggestions were made towards meeting the situation, one of them being a written communication from Mr. T. Henry Turner, of Birmingham. This embodied a proposal to institute a standard salt spray test, and another, that plating should be charged for on the basis of the demonstrable resistance to corrosion of the finished article. Both suggestions are excellent ones, but a good deal of heavy spade work will have to be done before the Society can discover a way of ascertaining the degree of demonstrable resistance, and the further means of training the customer to an appreciation of the circumstances, and a willingness to call for, and pay for, only the best work.

Die-Casting Alloys

DIE-CASTING in non-ferrous metals has grown enormously in favour of late years, and die-castings are highly popular in automobile work and other industries. It is gratifying, therefore, to learn, from the annual report of the Non-Ferrous Metals Research Association, that this branch of investigation is to receive continued support, during the coming year, from the Department of Scientific and Industrial Research. That portion of the work of the Association which relates to brass and bronze alloys has been carried out at the Research Department, Woolwich, and has been very successful. A number of improved alloys have been made for use as die-castings, with a strength considerably greater than those usually employed for such purposes, and attention has been devoted to the corrosive and erosive influence of the metals, in a molten state, on the moulds, whereby directions have been indicated for securing greatly increased life of the latter. The results obtained are such as to lead to the belief that there will be a great increase in the production of high-strength die castings in the industries using such parts. The corresponding work relating to light alloys for such purposes is being carried out at the National Physical Laboratory, and has had the effect of contributing greatly to the technical knowledge respecting this class of material. In particular, the study of gravity die-castings, and of the behaviour of aluminium alloys cast under pressure, has made substantial progress. Zinc-base alloys are being investigated in the laboratories of the University of Sheffield, and the behaviour of the mould materials towards attack by molten zinc and its alloys is similarly receiving attention. At Sheffield, likewise, work is in hand to provide essential data on the volume changes which occur in alloys with a low melting point, during solidification. Other investigations which the Non-Ferrous Research Association has in hand, which should be of very real value to the industries concerned, relate to gases in copper and bronze; the atmospheric corrosion of metals; the properties of lead; various copper alloys; and annealing practice in non-ferrous metals.

Magnetic Properties of Metals

THE properties and testing of magnetic materials is a highly specialised branch of metallurgy, and the average engineer, and the average metallurgist, while understanding the practical application and principles involved in routine work relating to a limited number of materials seldom possesses a generalised knowledge of the whole field involved. The latest book on the subject, *The Properties and Testing of Magnetic Materials*, by Mr. Thomas Spooner, the chairman of the Magnetic Properties Committee of the American Society for Testing Materials, will be the more welcome because it is an exceptionally well-written book and a model of what such a work should be. It is equally sound both in its theoretical sections and in the chapters devoted to a description of the methods and appliances employed in practical testing. Routine work in ascertaining the permeability, reluctivity and other properties of the various forms of iron and iron alloys, and the ascertainment of hysteresis losses and eddy current wastage in such materials, is often carried out in a perfunctory manner, and little account taken of important conditions which may greatly influence the results. Mr. Spooner brings out very clearly the subsidiary influences at work, such, for instance, as the selective and differential behaviour of various constituents, of scale, and segregates, upon the flux yields, so to speak, and a perusal of his work should go a long way towards helping the metallurgist and the engineer to devise metals and methods of treatment that should minimise the enormous economic losses in electrical power which so often occur—even to the extent of 50 per cent.—in the materials currently employed.

Blast Furnace Reactions

SOME results of extreme interest to all blast furnace managers are embodied in Technical Paper No. 397 of the United States Bureau of Mines, in which Mr. S. P. Kinney records the investigation of the composition of the stock at different points in a blast furnace, and thus throws a new light upon the nature of the reactions occurring at different zones. Three holes were driven through the outside casing and the lining. One was 19 ft. above the tuyère level (8 ft. above the bosh level and just below the sponge iron zone); a second hole was 27 in. above the centre line of the tuyères, and the third was at the tuyère level itself. Samples withdrawn from the highest point showed that 80 to 85 per cent. of the iron in the burden is reduced by the time it reaches this point, and that the sponge iron resulting from the reduction has taken up, or is in intimate contact with considerable quantities of carbon, sulphur, manganese, and silicon by the time it has reached

this level. Most of the silicon in the final metal has been taken up, while the metal is in the bosh, and above the 27 in. hole (87 per cent.), and the remainder enters it between this plane and the crucible. Silica in the coke ash has apparently little effect on the amount of the silicon in the metal, as most of this element has already entered it before the charge has worked down to the tuyère level. The report affords interesting information in regard to the behaviour of the other contaminating constituents as well. Thus, the preferential absorption of sulphur by the lime in the upper part of the furnace, is well brought out by Mr. Kinney's experiments.

25 Years Progress in Electro-Chemistry

OVER sixty papers were read at the recent general meeting of that exceedingly active body, the American Electro-Chemical Society. Not the least interesting of these papers was a series descriptive of the progress made in various branches of electro-chemistry and electrometallurgy during the last twenty-five years. These papers cover the practice in electrothermics generally ; in brass melting ; in electrolytic iron ; in the metallurgy of aluminium ; in electrolytic refining generally ; and in electrical precipitation. One of the most striking of these reviews of progress during the last twenty-five years is that by Mr. Cone, relating to the expansion in the manufacture of steel in the electric furnace in America. Indeed, that industry is not even twenty-five years old, as Mr. Cone puts its effective beginning as " just prior to 1909." At that period the estimated production was at the rate of some 14,000 tons per annum. In 1925 it had attained 615,512 tons. Of this amount nearly one-half consists of steel castings. A number of the other papers are devoted to what may be termed the metallurgy of direct reduction processes for the smelting and production of iron. Thus, Mr. Smalley deals with the Pehrson-Prentice process, and the Carsil process, which has of late been attracting not a little attention in England. The papers in themselves are commendably brief, and the proceedings of the society as a whole attain a very high level of scientific value and practical utility. As is well known to many, the progress of the Society is largely due to the devoted work of its secretary, Dr. Colin Fink, who himself contributed a paper on the " Gaseous Reduction of Tin Concentrates," and another on the closely allied subject of the " Gaseous Nature of Carbon Reduction of Tin Concentrates," to the proceedings of the recent meeting.

Standardisation of Elements in Cast Iron

THE April *Bulletin* of the British Cast Iron Research Association contains a note on the standardisation of elements in cast iron. The Association has found the following the most desirable order of expressing elements in cast iron when reporting chemical analyses : total carbon ; combined carbon ; graphitic carbon ; silicon ; manganese ; sulphur ; phosphorus ; nickel (if any) ; chromium (if any) ; other elements (if any). It is suggested that this order should be adopted as a standard for general use. The *Bulletin* also contains the following articles : " British Blast-Furnace and Cupola Practice," by J. E. Fletcher ; " The Strength of Moulding Sands," by J. G. A. Skerl ; " Nickel and Nickel-Chromium in Cast Iron : A Review of Published Work," by Dr. A. B. Everest : and a note on " Recent Developments in Cast Iron and Foundry Practice."

British Company to Operate Canadian Smelter

THE Ladysmith smelter, at Ladysmith, on Vancouver Island, is to be rehabilitated and equipped to handle ores from the coast mines. Mr. Herbert Carmichael, for many years Provincial Assayer of British Columbia, has returned from London, where he was successful, with the aid of Mr. H. B. Thomson, in financing the Ladysmith Smelting Co., and it is expected that the smelter will be in active operation by next October. The smelter, it is stated, will be operated by the British Metals Corporation, Ltd., of London, and it will be equipped with a custom mill for concentration of shipments of low-grade ores. It will receive silver-lead, zinc, and copper ores. It is understood that the receiving, weighing, and sampling devices at Ladysmith are being put into immediate operation, and that concentrates from the Dunwell mine, which have been contracted for, are already being received and will be shipped to England prior to opening of the smelter. This entry of British capital into British Columbia mining is looked on as of great importance, particularly as it is planned to acquire and develop properties as well as financially to assist prospectors and small companies to bring their properties into production.

Marking of Imported Iron and Steel

THE inquiry by the Standing Committee appointed by the Board of Trade, to inquire into the application of the National Federation of Iron Manufacturers for an order making compulsory the marking with the country of origin of certain classes of imported iron and steel, was concluded at Westminster on Tuesday. During the day Mr. H. J. Wallington, counsel for the iron and steel trades section of the London Chamber of Commerce, concluded his summing-up speech in opposition to the application. He contended that the evidence given by witnesses for the applicants showed that the real object of the request for compulsory marking was not to secure the purchaser against deception, but to force buyers into the British market and so reduce the importation of foreign steel. The imports affected by the application amounted to only 400,000 tons a year. Mr. M. Kissane, of the Manchester Ship Canal, summing up the objection of the Dock and Harbour Authorities' Association to the application, said if the order were made Customs examination of iron and steel for marks on the quays at the time of importation would cause congestion at the ports and delay shipping. Mr. J. Abady, for the applicants, submitted that the strength of the opposition showed that the order was promoted in the interest of the iron and steel trade of this country. The Federation asked for the order for marking on importation for several reasons, one of which was that, from the administrative point of view, it would be more difficult to trace infringements if the marking were on sale. The inquiry then closed, the chairman stating that the committee would report to the Board of Trade.

Empire Mining and Metallurgical Congress

ACCORDING to the *Congress News* for April, 1927, 756 persons have intimated to the Canadian Institute of Mining and Metallurgy their intention to take part in the congress in Canada next August. A further 1,329 ask for more information. While the programme of papers of the forthcoming congress is not yet complete it has taken shape very rapidly, and among other interesting contributions that have been promised for the various sessions it is interesting to note that the following articles have been arranged for : " Canadian Copper and its Production," by C. P. Browning ; " Impact Resistance of Steel at Low Temperature," by A. E. Cameron ; " Smelting Titaniferous Ores of Iron," by A. Stansfield ; " The Cascade Method of Pouring Steel," by J. G. Morrow ; " Nickel, Past and Present," by R. C. Stanley. Contributions from institutions overseas will probably include : the Institution of Mining Engineers—a paper on health safety problems ; the Institution of Mining and Metallurgy—a paper on the Empire question, by Sir Thomas Holland. The Iron and Steel Institute and the Institute of Petroleum Technologists will probably present one or more papers each.

Prizes for Arc Welding

THE American Society of Mechanical Engineers has accepted the custody of a sum of $17,500 offered by the Lincoln Electric Co., of Cleveland, Ohio, to be awarded in three prizes of $10,000, $5,000, and $2,500 for the best papers disclosing advance in the art of arc welding. The purpose of the competition, for which anyone in any country of the world may enter, is " to encourage improvements in the art of arc welding. the pointing out of new and extended applications of the process, the discovery of proved methods of testing welds to assure their integrity, or indicating advantages and economies to be gained by its use." The papers must be written in English, and must be dispatched by January 1, 1928, so as to arrive by January 31, to the secretary of the American Society of Mechanical Engineers, 29, West Thirty-Ninth Street, New York, to whom inquiries for further information should be addressed.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THERE have been one or two developments in the iron and steel trade during the past month, which may assist in warding off the depression that seemed to be settling down again on the industry. First of all there is the break in the price of coke. Last month it was pointed out that the 22s. price could no longer be maintained, and that 20s. was being readily quoted. Since then there has been a rapid change. The makers must have realised that they had made a great mistake in holding out for such unreasonably high prices, and the determined resistance of some of the pig iron makers compelled them to acknowledge this mistake and abandon the position which they had taken up. The price fell in quick stages, and to-day makers are glad to book contracts at 16s. to 17s. at the ovens if they can be obtained.

No Shortage of Coke

The previous shortage of coke, which caused the blast furnace owners so much inconvenience, no longer continues, and the position is reversed. Coke supplies are plentiful and it is becoming increasingly difficult to dispose of the output. Now it is the turn of the pig iron maker to dictate terms, and it is very probable that when contracts come to be renewed at the end of June the price will be down to 15s. at the ovens or less. On the whole, therefore, the coke makers have gained nothing by their attempt to take undue advantage of the abnormal demand which arose in the early part of the year. Even 19s. was too high a price, but if they had been content to keep to that price instead of increasing it, they would have done far more business and probably would not now be compelled to make such drastic reductions. However, the fall is very welcome to the iron and steel trade, as it represents an appreciable saving in the cost of production.

Another helpful feature has been the fall in the price of ferro-manganese. This is one of the high-priced commodities used in the manufacture of steel, and the associated English makers have kept the price fairly constant. Recently the market was very much disturbed by the threat of serious competition from abroad, and to meet this threat the English makers reduced their price £2 per ton. Steel makers were not slow to take advantage of this reduction, and a large amount of forward business has been booked at the new price, as it is generally felt that this low figure will not long hold good. Meanwhile the reduction will be of material assistance to the steel makers.

Scrap Steel in Foreign Demand

An interesting situation has also arisen in connection with scrap, another of the raw materials of the steel trade. The price of heavy steel scrap has fallen to 57s. 6d., which is lower than the pre-strike price. So far there has not been much eagerness to buy at this price, owing to the general fall in prices and the easing off in the demand for steel. Now the market is being influenced by a new factor. Germany is buying all the scrap that can be obtained in this country, and paying a price for it which, after all the carriage and f.o.b. charges are paid, is a little higher than the home market price. Consequently large contracts are being made for supplies to Germany, and already the scrap merchants are beginning to stiffen their prices for the steel works. It is significant that the railway companies, who are the chief source of supply of scrap for the steel works, are reserving large quantities of their stocks for the export market. If, therefore, the home demand remains anything like steady, some increase in the price must be expected.

The Coal Position

The coal trade is still in a very depressed condition, and seems to be getting worse. The supply far exceeds the demand, and short time is increasing at the collieries. When contracts come to be renewed at the end of June it is expected that some low prices will be in evidence, and certainly the steel makers will take advantage of the dullness of the market. Cheap fuel is still a necessity if the steel trade is to prosper, and just now the prospects are distinctly more favourable, both in coal and coke, than they have been since the strike. The colliery owners contend that they are losing money at present prices, and that is probably true, but that will not save them from having to make further reductions.

Following the usual practice, all the relief which has been obtained in the reduced prices of raw materials has been handed over to the consumers in the lower prices quoted for pig iron and steel generally. There have been two reductions of 5s. each in the price of pig iron during last month, and it can now be bought at 70s. to 72s. 6d. at the furnaces. The state of the pig iron market made a fall in price inevitable. There was no buying, and makers were faced with the alternatives of curtailing production, or of putting iron into stock, a costly proceeding at the present production cost. Even the bold reduction in the selling price has not improved the market to any great extent, and there is still not much buying. Consumers are evidently not satisfied that the bottom has been reached and they are holding off in the hope of further reductions.

Hæmatite Iron

Hæmatite iron has also fallen, as was expected. In this section of the trade also, the output exceeded the demand and large stocks were being accumulated. Some of the makers are now damping down their furnaces rather than increase the stocks. Selling prices have been reduced by two steps of 2s. each, but these reductions have not materially improved the demand, and buyers are taking only what they need for present requirements. There is little doubt that further reductions will have to be made, and from the consumers' point of view a waiting policy is certainly the best.

Steel prices are nominally unchanged for the home market. The associated makers had a meeting a week or two ago and decided that the official prices for the home market should remain as they were, but that the export prices should be advanced 2s. 6d. per ton, the last step being no doubt a response to the recent advance in the price of continental steel. The home prices therefore remain at £8 2s. 6d. to £8 7s. 6d. for plates, according to the district, and £7 12s. 6d. for sections. These nominal prices for plates are the maximum prices quoted to-day, and in many instances they are shaded, as the demand for heavy plates is not at all good. Sections have hitherto been rather firm at 2s. 6d. to 5s. above the association figure, but £7 12s. 6d. is now becoming the maximum price quoted. Really one cannot see any justification for any further reductions, as these prices cannot possibly be remunerative to the makers. Steel billets have also fallen in price, and one hears of quotations as low as £7 per ton.

Future Prospects

The inflow of orders to the steel works is not improving, and order books are now rapidly diminishing. The tone of the iron and steel exchanges is doleful, and the future is not looked forward to with any confidence. The usual forecast is now freely made, that there will be no improvement until the autumn. That is certainly the feeling in Lancashire, as the Whitsuntide holidays are now approaching, and after that the local holidays will prevent any revival of business for a month or two. The number of steel works which can claim to be still on full output must be very small. With many of them the position is very much worse. Some of the largest plate makers on the North-East coast are already running the mills on short time.

Nevertheless there are those who are still optimistic enough to predict a revival in trade in the near future. One reason given for the present dullness is the enormous quantity of steel delivered to consumers during the first four months of the year. The home production was over 3,300,000 tons and the imports of steel amounted to over 1,800,000 tons. No doubt these excessive imports represent the balance of the contracts entered into during the strike. Taking the two figures together it can be readily understood that the delivery of such huge quantities must have had something of a choking effect, and would effectually put a stopper on new buying until these deliveries had been assimilated.

The production figures for April show the effect of the Easter holidays when compared with March. Pig iron amounted to 680,000 tons, as compared with 671,800 tons in March. There were 11 more furnaces in blast at the end of the month than at the beginning. The output of steel ingots and castings was 850,100 tons compared with 949,600 tons in March.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Blast Furnaces

AN elaborate machine for tapping blast furnaces is described by B. J. Mullen, of Columbiana, Ohio, U.S.A. The drill is operated by a reciprocating fluid pressure engine mounted on a frame for longitudinal movement thereon. The entire machine is fixed in position for tapping and is arranged to be entirely operated from a distance, thus avoiding danger to the operator. After tapping, the whole machine is moved away. For further details the specification, which contains numerous and elaborate drawings, should be consulted. See Patent No. 267,722, having the date March 29, 1926.

Copper and Zinc

ACCORDING to a patent by W. Carpmael, London, from I.G. Farbenindustrie Akt.-Ges., of Frankfort-on-Main, Germany, minerals difficult of attack, containing more than one metallic compound are ground with appropriate reagents, the temperature or concentration or nature of the latter being varied so as to effect successive elimination of the constituents. Thus a complex zinc-copper-lead sulphide, coarsely divided, is ground in a ball mill with sulphuric acid at a temperature such that the zinc only is at first eliminated. At a higher temperature copper is eliminated while lead sulphate remains. See Patent No. 267,433, having the date November 10, 1926.

Zinciferous materials containing other valuable constituents such as lead, copper, or noble metals, instead of being smelted for zinc in muffle-furnaces, are subjected to two smelting operations in a shaft furnace. In the first the operation is conducted so as to volatilise the lead, cadmium, and a little zinc to form a lead-zinc pigment, while leaving the major portion of the zinc in a slag and the copper and noble metals in a matte. The zinc-containing slag is then smelted with a reducing agent and fluxes if necessary so as to volatilise the zinc as zinc oxide, which is recovered in the usual way. When such ores are treated by the muffle furnace process the residues do not lend themselves to the extraction of the copper and other metals. See Patent No. 268,201, having the date July 22, 1926.

Copper Alloys

M. G. CORSON, of Jackson Heights, New York State, U.S.A., finds that copper can be rendered incapable of annealing at 450° C. by alloying it with 0·3 to 2 per cent. of chromium or 1 to 6 per cent. of cobalt, quenching at 900 to 975° C., and then working mechanically. The alloys are particularly useful for spring devices which have to withstand a fairly high temperature, as in thermoregulators. See Patent No. 268,200, having the date July 21, 1926.

The Metallbank und Metallurgische Gesellschaft Akt.-Ges., of Frankfort-on-Main, Germany, in two patent specifications, having the International Convention date April 15, 1926, describe copper-aluminium alloys whch possess unusual strength at high temperatures and are specially suitable as bearing metals. They can also be readily hot-pressed. According to Patent No. 268,225, copper is alloyed with 5 to 9·5 per cent. of aluminium, 1 to 6 per cent. of manganese, 0·1 to 3 per cent. of iron and 0·1 to 3 per cent. of nickel; a similar alloy, without the nickel, has already been suggested as suitable for turbine blades. According to Patent No. 268,654, copper-aluminium alloys contain also 1 to 6 per cent. of manganese and 0·01 to 2 per cent. of tin.

Aluminium

ACCORDING to a patent application by the Aluminium-Industrie Akt.-Ges., Neuhausen, Switzerland, aluminium is refined electrolytically using a fused electrolyte, but under such conditions that both the anode and cathode are in the solid state. The double chlorides, bromides, and iodides of aluminium with alkali or alkaline earth metals are suitable as electrolytes, and the temperature may be from 80 to 600° C. according to the salt or salts used. To avoid solution of the anode alloy in the electrolyte the former should contain sufficient silicon to combine with the iron present. Aluminium or other metal cathodes are used. See Patent Application 265,170, having the International Convention date January 27, 1926.

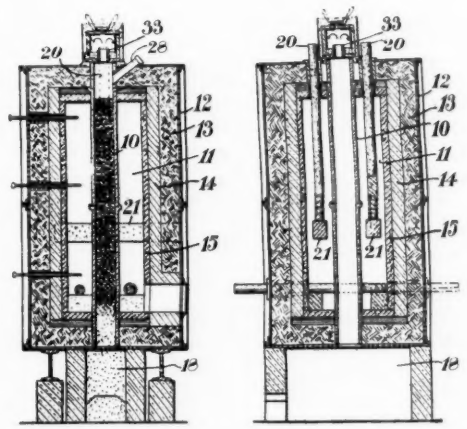
The Metallbank und Metallurgische Ges. Akt.-Ges., Frankfort-on-Main, Germany, find that aluminium and its alloys can be freed from impurities such as carbides or calcium by treatment with alumina in the dissolved or fused state. Thus the alloying of aluminium-silicon with aluminium may be effected under a layer of alumina. See Patent Application No. 265,563 having the International Convention date February 8, 1926.

According to a patent application by R. Selz, Munich, Germany, an addition of metals such as copper, nickel, and magnesium is made, in the form of a preliminary alloy, to aluminium alloys which may contain up to 18 per cent. of zinc. Thus 2 per cent. of an alloy containing copper, nickel, and magnesium is added to an aluminium-zinc alloy. The products may be tempered. See Patent Application No. 266,720, having the International Convention date, February 27, 1926.

Zinc

ACCORDING to a patent by P. C. Rushen, London, from the New Jersey Zinc Company, U.S.A., zinciferous materials are briquetted together with a carbonaceous reducing agent and reduced in a vertical retort externally heated. Compared with non-briquetted material the whole mass is readily heated by convection currents in the gases in the interstices between the briquettes without it being necessary to raise the walls of the retort to an excessively high temperature. The zinc distils from the top, and may be condensed as dust or liquid or

FIG. 1. *FIG. 2.*



269,324

oxidised and collected as zinc oxide. The furnace may be worked continuously or intermittently. Figs. 1 and 2 show side and front sectional elevations of a form of furnace. The retort 10 is surrounded by a heating space 11, enclosed by the usual casing 12, 13, 14, having a graphite lining 15. Heating may be effected by combustion products or preferably electrically. In the latter case graphite electrodes 20 are provided, the electric circuit being completed through the supports 21, and the graphite furnace lining. The charge is introduced at 28, and the residue removed through the closed chamber 18. The zinc vapour emerges through the nozzle 33, and is condensed in the surrounding condenser. See Patent No. 269,324, having the date April 10, 1926.

It is known that zinc sulphate solutions can be freed from cobalt—the presence of which is detrimental in separating zinc electrolytically—by precipitation with a mixture of soluble copper and arsenic compounds. According to a patent by R. H. Stevens, G. C. Norris, and W. N. Watson, Broken Hill, Rhodesia, this method fails when applied to the removal of nickel unless the solution is free from and not in contact with organic substances of all kinds, particularly canvas and wood, and the tar oils, xanthates, and organic acids commonly used in froth flotation processes; silica and alumina are also objectionable. It is preferred to carry out the purification of the zinc solution in an apparatus entirely lined with lead. See Patent No. 269,776, having the date August 23, 1926.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The present state of the problem of the fusion of alloys. M. Fourment. *Rev. Métallurgie*, April, pp. 179-193 (in French).

On the miscibility gap in liquid iron-copper alloys. A. Müller. *Z. anorg. u. allg. Chem.*, May 13, pp. 231-236 (in German).

Variations in the mechanical properties of steels and alloys with temperature. A. Michel and M. Matte. *Rev. Métallurgie*, April, pp. 200-209 (in French).

Contribution to the knowledge of Tula (Nyello) alloys. An investigation of the system Cu_2S—Ag_2S—PbS. R. Schwarz and A. Romero. *Z. anorg. u. allg. Chem.*, May 13, pp. 149-160 (in German).

CORROSION.—The protection (against corrosion) of aluminium, magnesium, and light and ultra-light alloys. J. Cournot, J. Bary, and E. Perot. *Comptes Rend.*, May 16, pp. 1172-1174 (in French).

The intercrystalline corrosion of metals. H. S. Rawdon. *Ind. Eng. Chem.*, May 1, pp. 613-619.

GENERAL.—The reactions of metals with dry salts at high temperatures. B. Garre. *Metall. u. Erz.*, May, Vol. XXIV (10), pp. 230-232 (in German). Reactions between solid substances can proceed in the absence of liquid or melt on heating the mixture, if by the reaction heat is set free. The reactions proceed to complete exhaustion of the original components. The possibility of practical application of the phenomenon is discussed.

The action of salts on metals. T. Peczalski. *Comptes Rend.*, May 16, pp. 1159-1161 (in French).

The value of the uniformity of brasses in foundry products. F. Doerinckel. *Continental Met. Chem. Eng.*, May, pp. 131-134 (in English).

The embrittlement of boiler plate. S. W. Parr and F. G. Straub. *Ind. Eng. Chem.*, May 1, pp. 620-622.

The determination of the temperature of the commencement of recrystallisation. G. Tammann and W. Salge. *Z. Metallkunde*, May, pp. 187-188 (in German).

IRON.—The production of cast iron and synthetic pig iron in the electric furnace. H. Stamm. *Continental Met. Chem. Eng.*, May, pp. 135-138 (in English).

Carbon and silicon in cast iron. A. E. Allinson. *Foundry Trade J.*, May 12, pp. 397-399.

The heat treatment of grey cast iron and semi-steel. O. W. Potter. *Foundry Trade J.*, May 5, pp. 371-374; May 19, pp. 413-416.

MAGNETIC PROPERTIES.—The influence of cold-hardening and of annealing on the magnetic properties of thin wires of invar, iron, and steel. C. Biéler-Butticaz. *Arch. des Sciences*, Jan.-Feb., pp. 32-51 (in French).

The nature of the magnetic transformation of iron. F. Wever. *Z. anorg. u. allg. Chem.*, May 13, pp. 193-202 (in German).

Magnetism and crystal structure in manganese-aluminium-copper (14-10-76 per cent.) alloys. F. Heusler. *Z. anorg. u. allg. Chem.*, March 14, pp. 159-160 (in German).

SINGLE METALS.—The question of the polymorphism of zinc. G. J. Petrenko. *Z. anorg. u. allg. Chem.*, May 13, p. 251 (in German).

The building up of structure and the formation of surfaces in poured copper. P. Sieber and L. Katterbach. *Z. Metallkunde*, May, pp. 177-186 (in German).

STEEL.—Contribution to the study of the deformation accompanying the heat treatment of steel. A. Portevin and A. Sourdillon. *Rev. Métallurgie*, April, pp. 215-233 (in French).

The cause of the instability of nickel steels. C. E. Guillaume. *Arch. des Sciences*, January-February, pp. 5-15 (in French).

The importance of cementite. R. G. Guthrie. *Trans. Amer. Soc. Steel Treating*, March, pp. 341–354. Gives reasons for the view that the condition of cementite is of great importance, and that in low carbon steels which are not to be subjected to hardening it is desirable that the cementite be in the spheroidal form, but that in high carbon steels which are to be hardened it is desirable to have the cementite in lamellar form.

The fatigue strength of hard steels and their relation to tensile strength. J. M. Lessells. *Trans. Amer. Soc. Steel Treating*, March, pp. 413–424. An application of fine extensometers to the measurement of elastic properties is made in connection with tensile properties. The relation between tensile strength, Brinell hardness, and endurance limit is discussed, and it is shown how residual stresses present in the material may influence such a relationship. The superiority of medium carbon steel in gear application is shown by the results obtained.

Facts and principles concerning steel and heat treatment. XI. H. B. Knowlton. *Trans. Amer. Soc. Steel Treating*, March, pp. 450–463. Considers the influence of chromium on properties of steel. Guillet's diagram showing the structural composition of steels of varying chromium and carbon contents is discussed. The composition, properties, uses, and methods of heat treating a number of types of chromium steel are described. Stainless steel and the principles of corrosion are briefly considered.

SYSTEMS.—The binary system manganese-zinc. C. L. Ackermann. *Z. Metallkunde*, May, pp. 200-204 (in German).

The ternary system silver-tin-copper. W. Guertler and W. Bonsack. *Z. anorg. u. allg. Chem.*, May 13, pp. 22-30 (in German).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BRITISH PLATINUM AND GOLD CORPORATION, LTD., London, E.C. Registered May 6, £1,000 and £150 debenture stock, part of £50,000; general charge. *£15,000. January 14, 1927.

EBBW VALE STEEL, IRON, AND COAL CO., LTD. Registered April 21, charge to bank; charged on 1,715 railway wagons. *£573,000 to secure bank overdraft, £781,200. July 13, 1926.

MONDEGO VALLEY TIN SYNDICATE, LTD., London, E.C. Registered April 14, £10,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £7,000; general charge (subject to prior debs.). *£45,000. December 2, 1926.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield. Registered May 3, £950 debentures part of £750,000; general charge (except uncalled capital and certain property). *£582,350. October 12, 1926.

TREDEGAR IRON AND COAL CO., LTD., London, E.C. Registered May 6, £140,500, £3,200 and £800 debentures, part of amount already registered; general charge. *£3,300 old series, £400,000 new series. August 13, 1926.

WOLSTANTON, LTD., near Shifnal, ironmasters. Registered April 28, £41,200 debentures part of £100,000; general charge. *£40,000. May 3, 1926.

Satisfaction

PALMERS SHIPBUILDING AND IRON CO., LTD., Jarrow-on-Tyne. Satisfactions registered April 13, £57,620, outstanding July 1, 1908; and £3,200 and other moneys registered June 9, 1913.

A Recent Appointment

MR. E. H. LEWIS, formerly works manager of the Glasgow Iron and Steel Co., Ltd., Wishaw, has been appointed general manager to the company, in succession to the late Mr. Macaulay. Mr. Lewis was for four years president of the West of Scotland Iron and Steel Institute, and has been at Wishaw since 1914.

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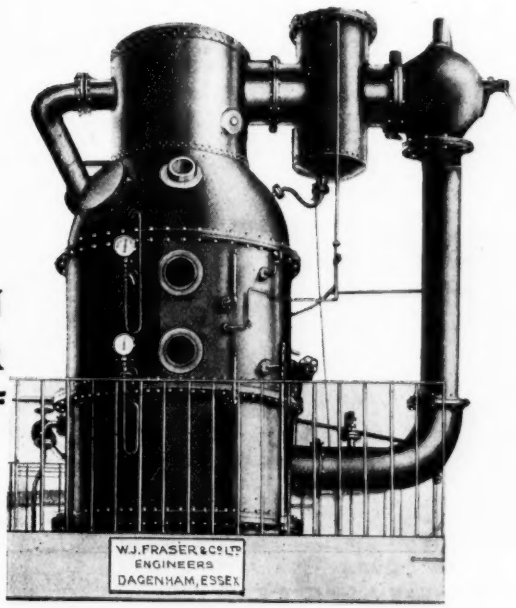

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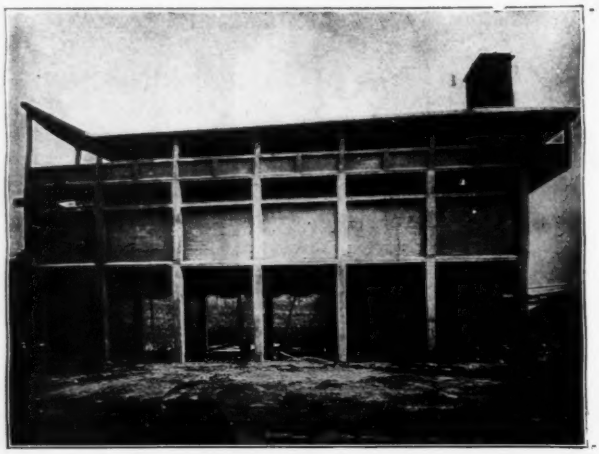

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INDEX TO ADVERTISERS

Acme Chemical Co., Ltd. ..... xv, Feb. 26
Aluminium Plant & Vessel Co., Ltd. xx
Anderson (D.) & Son, Ltd. ..... xviii, June 11
Andrews (R. W.) & Co. ..... xxxi, June 11
Anglo-American Oil Co., Ltd. ..... xix, Jan. 8
Anglo-Scottish Chemical Co., Ltd. xix
Attwood's Spraying Equipment Co., Ltd. vi, June 11
Averill (C. R.), Ltd. ..... xv, Feb. 26

Babcock & Wilcox, Ltd. x
Baker Perkins, Ltd. x
Barter Trading Corporation, Ltd. .. xvi, June 18
Beck (R. & J.), Ltd. ..... xviii, June 4
Bell (G.) & Sons, Ltd. ..... v, April 30
Benn Bros., Ltd. ..... vi, June 18
Benn (Ernest), Ltd. xxiv
Bennet Furnishing Co., Ltd., The .. ii, April 30
Bennett & Jenner xxv
Berk (F. W.) & Co., Ltd. ..... xx, May 7
Blagden (Victor) & Co., Ltd. *Front Cover*, June 18
Boby (Wm.) & Co., Ltd. ..... xxviii, June 11
Boots Pure Drug Co., Ltd. ..... xiii, June 11
S. Bornett & Co., Ltd. .... *Front Cover*, May 21
Brinjes & Goodwin, Ltd. xxiii
British Alizarine Co., Ltd. ..... xix, June 11
British Drug Houses, Ltd. xxii
British Dyestuffs Corporation, Ltd. xxi, June 11
British Ebonite Co., Ltd. ..... *Cover* ii, June 18
British Hanovia Quartz Lamp Co., Ltd. vii, June 11
British Mills Foundry ..... xiii, June 18
British Oxygen Co., Ltd. ..... xiv, June 18
British Resistor Co., Ltd. ..... xxii, Feb. 25
British Rotary Filter Co., Ltd. xiv
Broadbent (Thos.) & Sons, Ltd. xxii
Brotherton & Co., Ltd. ..... xvii, June 18
Brough (E. & A.) & Co. ..... xvii, June 11
Brown & Son viii
Brunner, Mond & Co., Ltd. ..... ii, June 18
Buhler Bros. ..... xv, June 11
Burckhardt Engineering Works vii
Burns (Glasgow), Ltd., Wm. ..... vii, April 2
Burt, Boulton & Haywood, Ltd. ..... i, Jan. 22
Buxton Lime Firms Co. ..... vii, June 18

Cain (G. R. L.) viii
Cannell (W.) & Co. ..... ii, May 7
Carbic, Ltd. ..... *Cover* iv
Carter (J. Harrison), Ltd. ..... xvi, June 11
Carty & Son, Ltd. xii
Castner-Kellner Alkali Co., Ltd. .... ix, June 18
Chance & Hunt, Ltd. ..... xi, June 18
Chemco ..... ix, Feb. 19
Chesterfield Tube Co., Ltd. xiv
Christopher (J.) & Sons, Ltd. ..... x, June 11
Christopherson (C.) & Co. ..... *Cover* iii
City of Manchester Education Committee iii, June 18
Clifford (Chas.) & Son, Ltd. ..... xxi, June 4
Clyno Engineering Co. [1922] Ltd. xiii
Cole & Wilson ..... iv, June 18
Collett (J. M.) & Co., Ltd. xvi
Compagnie Commerciale du Nord (Great Britain), Ltd. ..... xxvi, Jan. 1
Connell (A.) & Co. ..... vii, Feb. 19
Cook (Chas. W.) & Sons xii
Cramm-Muhlen-Gesellschaft viii
Crane (Fredk.) Chem. Co. *China Clay* 11, June 18
Crossley Bros. ix
Cuthbertson (Jas.) & Co., Ltd. ..... xiii, June 4

Dale (John) Mfg. Co. iii
Danto-Rogeat & Cie ..... xvii, June 18
Dexine, Ltd. ..... ii, June 11
Dickinson (Arthur J.), Ltd. ..... *Cover* iii
Dixon (Joseph) Crucible Co. ..... xi, May 28
Dixon (T. H.) & Co., Ltd. xxi
Dorking Greystone Lime Co., Ltd. .... iv, June 4
Dorr Co. xviii
Durastic Bituminous Paint Co. .... xx, June 11

Edwards (W.) & Co. ..... iii, June 11
Electroflo Meters Co., Ltd. ..... *Cover* iv, June 4
Escher, Wyss & Co., S.A. ..... ii, Jan. 29
Evans, Adlard & Co., Ltd. .... xxxii, June 11
Everseal Products, Ltd. ..... xxii, June 11

Feltham (W. H.) & Son iii
Fertilizer Sales, Ltd. ..... xii, Jan. 1
Firth (Thos.) & Sons, Ltd. ..... 587, June 18
Foamite Firefoam, Ltd. ..... 543, June 4
Follows & Bate, Ltd. ix
Foster Instrument Co. v
Foyle (W. & G.) ..... xxvi, May 28
Fraser & Chalmers ..... xvi, Mar. 5
Fraser (W. J.) & Co., Ltd. i
Fuller's United Electric Co., Ltd. .. viii, April 23
Fuller's Earth Union, Ltd. ..... xv, June 11
"Fullersite" ..... xiv, June 11

Gallenkamp (A.) & Co., Ltd. ..... iii, May 21
Gardner (Wm.) & Son .. *China Clay* 3, June 18
Gas Light & Coke Co. xviii
Geigy Colour Co., Ltd. ..... xv, April 9
General Chemical and Pharmaceutical Co., Ltd. (The) xv
Gledhill Brook & Co., Ltd. .... xxxiii, June 11
Glenboig Union Fire Clay Co., Ltd. xxi, June 18
Greeff (R. W.) & Co., Ltd. ..... ix, June 18
Griffiths Bros. & Co. (Lond.), Ltd. .... *Cover* ii
Grose & Stocker ..... *China Clay* 12, June 18
Grove Johnson, F.I.C. (Lond.) .. xviii, June 18
Guelph Patent Cask Co., Ltd. ..... v, April 2
Guthrie & Co. ..... *Cover* iii, May 28

Hadfields, Ltd. ..... xviii, May 7
Haughton's Patent Metallic Packing Co., Ltd. ..... xix, Mar. 26
Heinemann, Wm. (Medical Books), Ltd. xii, April 30
Hensman Bros. xv
Herz & Co. vi
Hewitt Construction Syndicate, Ltd. xxv
Hickson (E.) ..... viii, June 11
Hislop (R. & G.) ..... xxii, April 30
His Majesty's Stationery Office .... xix, May 7
Holden & Brooke, Ltd. ..... *Cover* ii
Holland (Bernard) & Co. ..... xiv, June 11
Holst (K.) & Co. ii
Honeywill Bros., Ltd. xxiii
Hopkin & Williams, Ltd. ..... xi, June 18
Hopkins (G.) & Sons, Ltd. ..... xxi, Mar. 5
Horne Engineering Co. ..... *Cover* iii, June 18
Howards & Sons, Ltd. ..... *Front Cover*
Hoyle (Joshua) & Sons, Ltd. ..... x, May 7
Hunt (J. T.) & Son ..... iii, June 18
Hurrell (G. C.) & Co. iv

Industrial Combustion Engineers, Ltd. xvii
Industrial Spirit Co., Ltd., The. *Cover* ii, Mar. 12
Institute of Chemistry xvi
Integra Co. ..... v, April 30

FOR CLASSIFIED INDEX TO TRADES SEE PAGES xxii & xxiii

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INDEX TO ADVERTISERS—*Continued.*

nternational Combustion Co.....vi, June 18
International Electrolytic Plant Co., Ltd. ..xxii
International Trades Exhibition.....i, June 11
James & Co.....xviii, April 30
Jarvie (Wm.) .....xviii, April 30
Jenkins Bros., Ltd.....xx, June 11
Jobling (James) & Co , Ltd.....viii
Johnson (C. H.) & Sons, Ltd. .....vii, June 4
Johnson (S. H.) & Co., Ltd.....xxii
Johnson, Matthey & Co., Ltd. vii
Kek, Ltd.....xiv, May 7
Kelvin, Bottomley & Baird, Ltd.
Cover iii, June 18
Kennicott Water Softener Co., Ltd. xx, June 11
Kestner Evap. & Eng. Co., Ltd.....x
Key Engineering Co. .....xxxiii, June 11
Lancaster & Tonge, Ltd.....*Cover* iii
Lautenschläger (F. & M.) .....xii, May 7
Leeds & Bradford Boiler Co., Ltd...xiii, June 18
Le Grand, Sutcliffe & Gell, Ltd. ..xx, June 11
Leigh (R. H.), Ltd. .....xii, June 11
Leitch (J. W.) & Co., Ltd. .....xiii, June 18
Lennox Foundry Co., Ltd. .....viii, June 18
Lever Brothers, Ltd.....*Cover* ii
Lilleshall Co., Ltd. .....xiv, June 18
Liverpool Refrigeration Co., Ltd.....xxiii
McGraw-Hill Publishing Co., Ltd. xiv, June 11
MacKechnie (R. D.) & Co. .....xvi, May 28
Malehurst Barytes Co., Ltd. .....vi, Feb. 26
Manchester Oxide Co., Ltd.....xiii, June 11
Manlove, Alliott & Co., Ltd.....ii, June 11
Mayhew, Ramsay & Co., Ltd.....565, June 11
Meadow Foundry Co., Ltd.....xv, June 18
Metal & General Agency, Ltd. ....viii, April 16
Metcalf & Co. .....viii, June 11
Miller (Jas.), Son & Co., Ltd.....viii, Mar. 26
Miller's Steel Drums, Ltd. vi
Millwards Merchandise, Ltd. .....xii, June 18
Mitchell, L. A. .....x, June 18
Mitchell (P. D.), Ltd.....xxv
Mond Nickel Co., Ltd. .....xii, June 18
Mond Staffordshire Refining Co., Ltd..i, June 18
National Glass Industry .....vi, April 30
National Time Recorders, Ltd. xxii
Negretti & Zambra .....*Cover* ii, June 11
Nicolson, W. B. .....xxi, April 30
Nobel Chemical Finishes, Ltd. ....xiii, June 4
Oertling (L.), Ltd. .....xiii, June 4
Ogilvy & Co. .....xvi, June 4
Ohlenschlager Bros. .....xi, June 18
Oliver Continuous Filter Co.....xxi
Page (Chas.) & Co., Ltd. .....xv, June 18
Paisleys, Ltd. xv
Paterson Engineering Co. .....xviii, June 11
Pearce (L. R. B.), Ltd. .....xix, June 18
Pemberton (A.). Ltd. .....ix, April 30
Perry & Hope, Ltd. xvi
Phillips (J. W. & C. J.).....xi, June 11
Pneumatic Conveyance & Extraction, Ltd.
xi, Jan. 15
Pott, Cassels & Williamson.....xii, June 18
Pragos Engineering Co. .....*Cover* iv, June 18
Premier Filterpress Co., Ltd.....xx
Preston (J.) xvi
Price, Stutfield & Co., Ltd. *Front Cover*, May 28
Prodorite, Ltd. xix
Pure Bone Phosphate & Chemical Co., Ltd.. xiv
Puttick, H. C. .....v, May 21
Pyrene Co. (The), Ltd.....xv, June 18
Quaker Oats, Ltd. xix
Randall (C. W.) & Sons, Ltd. ....xiv, Nov. 20
Rapid Annoncen-Expedition ..xxviii, Mar. 12
Rowat (Alex) & Co., Ltd. .....xxi, June 18
Rowlandson (W.) & Co. xxv
Royal Metal Trades Pension & Benevolent
Society.....xviii, June 4
Rubber Industries, Ltd. .....ix, June 4
Ryding & Co. .....*Cover* iii, June 18
Sands, Hunter & Co. .....xxii, June 11
Scientific Glass Blowing Co. vi
Scientific Supplies Co. .....xxii, April 30
Scott (G.) & Son (London), Ltd.
Front Cover, June 11
Scott, Bader & Co., Ltd. .....xviii, June 18
Scottish Dyes, Ltd. v
Sentinel Waggon Works, Ltd. .....ix, June 4
Sherman (J.) & Co.....vii, June 18
Shirley Aldred & Co., Ltd.....xxv
Siebe, Gorman & Co., Ltd. ....xxviii, June 11
Simon (R.) & Sons, Ltd.....xxii
Sloog, H. .....xvii, June 18
Sofnol, Ltd. xi
Spencer Chapman & Messel, Ltd. xxii
Spink & Son, Ltd. .....xvi, June 4
Statham (John) & Sons .....v, June 11
Steel Barrel Co , Ltd. .....*Cover* ii
Stockton-on-Tees Chemical Works, Ltd.
Cover iii, June 4
Stott (James), Ltd. xvi
Stream Line Filter Co., Ltd.....xxix, April 30
Sugden (T.), Ltd.....xxix, April 30
Tanks & Drums, Ltd. .....xxi, June 18
Telechron Electric Co.....ix
Tennant (C.) & Co., Ltd. vi
Tennant (C.), Sons & Co., Ltd.....*Cover* iv
Thermal Syndicate, Ltd. 613
Thompson & Capper, Ltd.....*Cover* iii
Tinsley (H.) & Co.....viii, April 30
Todd Bros.....x, June 18
Townson & Mercer, Ltd. .....v, June 18
Trade Papers Publishing Co., Ltd...vi, Feb. 26
Trist, Ronald, & Co., Ltd. ix
Turner (R. B.) & Co.....xxi, June 18
Unit Manufacturing Co. .....x, June 11
United Alkali Co., Ltd. ..*Front Cover*, June 4
United Water Softeners, Ltd. ....xvi, June 18
Uno Products Co.....iv
Varcoes China Clay Co., Ltd.
China Clay 4, June 18
Visco Engineering Co., Ltd. ....xxii, June 11
Wallach Bros. ....xxii, June 11
Wardale (John) & Co., Ltd. xvi
Warrington Chem. & Drug Co., Ltd.....xix
Webb (W. A.) Ltd.....xii, April 30
Weinreb, F. .....*Cover* iv, June 11
Weir (G. & J.), Ltd. .....xvi, June 4
Wells (A. C.) & Co.....viii
Wengers, Ltd. .....xxi, June 18
Western Chem. Co. (Paisley), Ltd. vii
Westinghouse Brake and Saxby Signal Co.
xxiv, June 11
West's Gas Improvement Co., Ltd. .iv, June 18
White Electrical Instrument Co., Ld. v, June 18
Widnes Foundry Co., Ltd. viii
Wilkinson (Jas.) & Son, Ltd.....iii, June 11
Wilcox (W. H.) & Co., Ltd. ..xxviii, June 11
Woolley, Jas., Sons & Co. xv
Wright (Alex.) & Co., Ltd.....ii

FOR CLASSIFIED INDEX TO TRADES SEE PAGES xxii & xxiii

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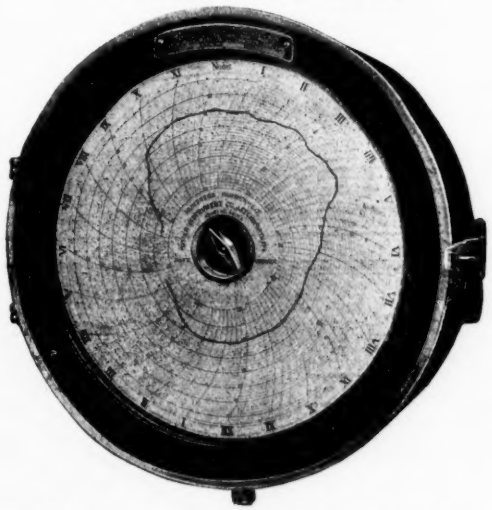

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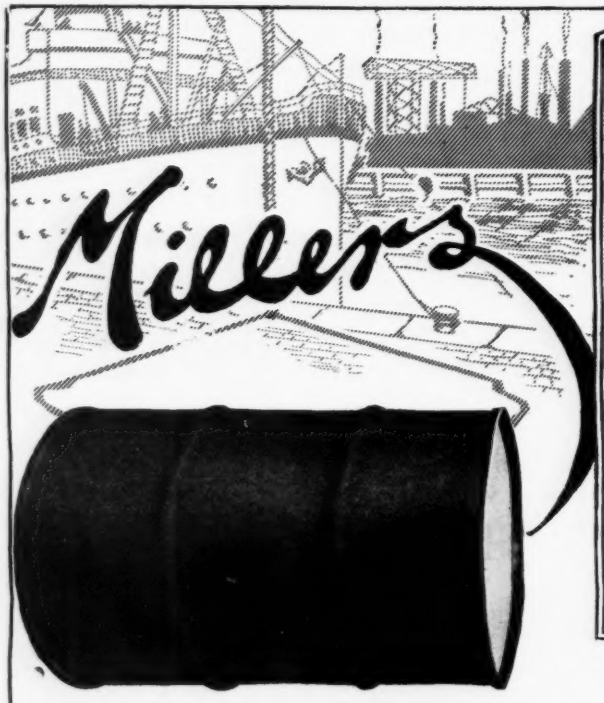

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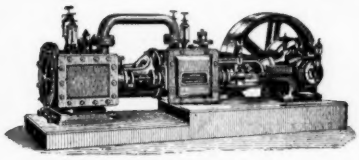

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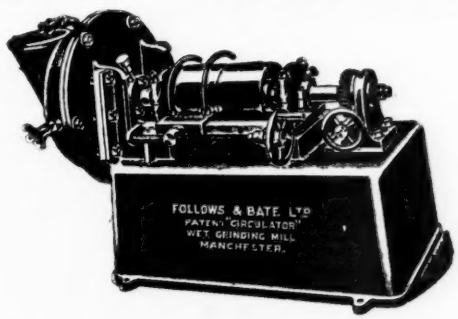

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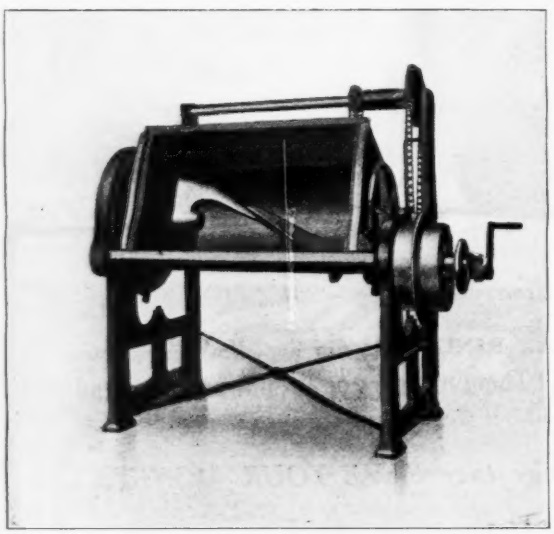

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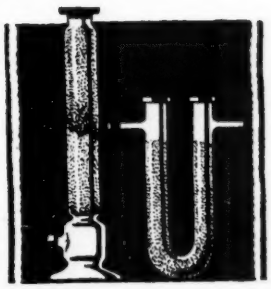

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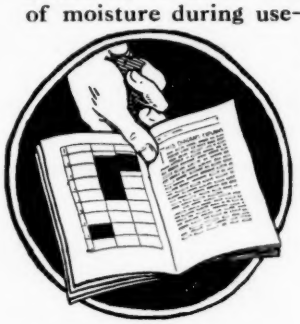

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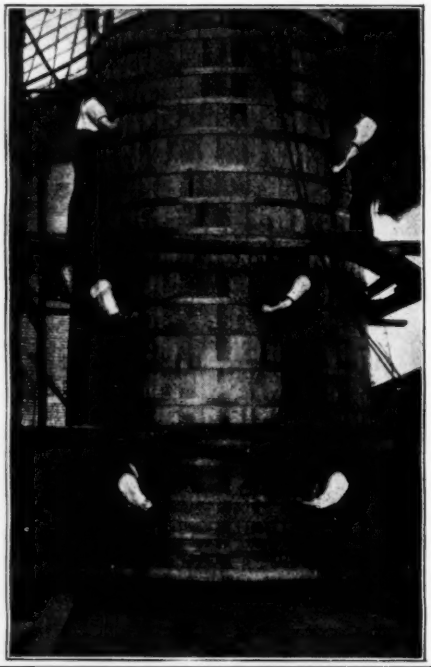

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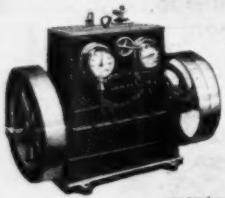

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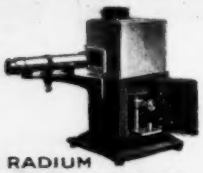

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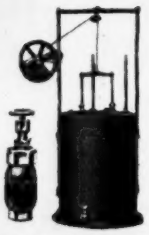

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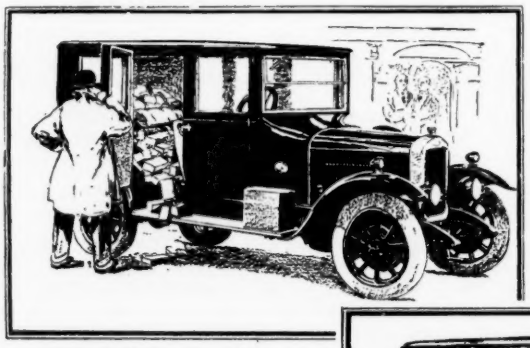

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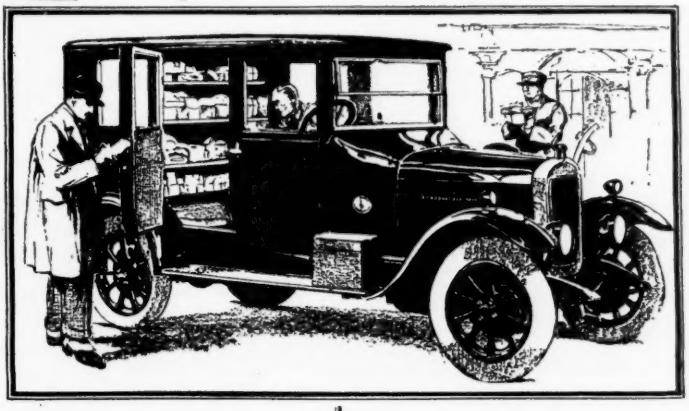

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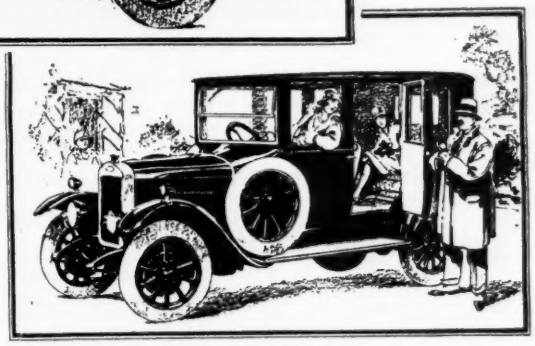

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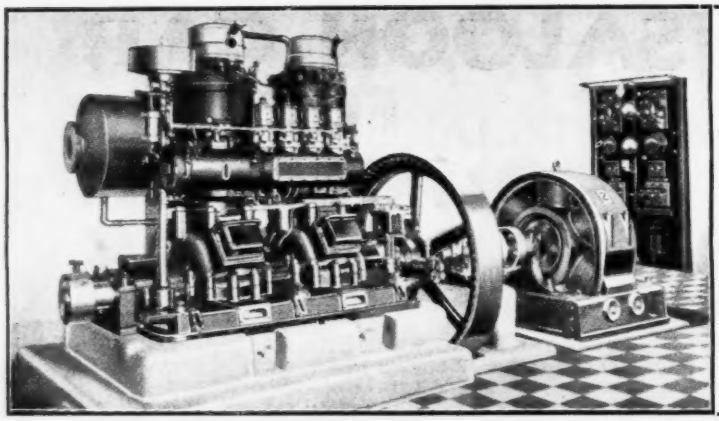

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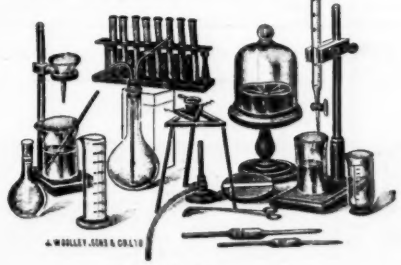

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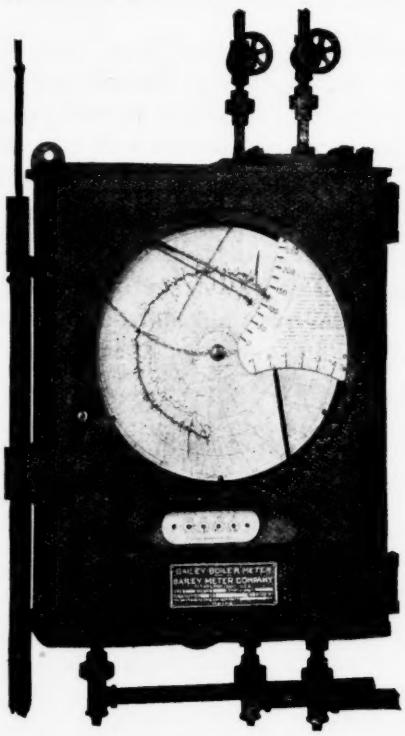

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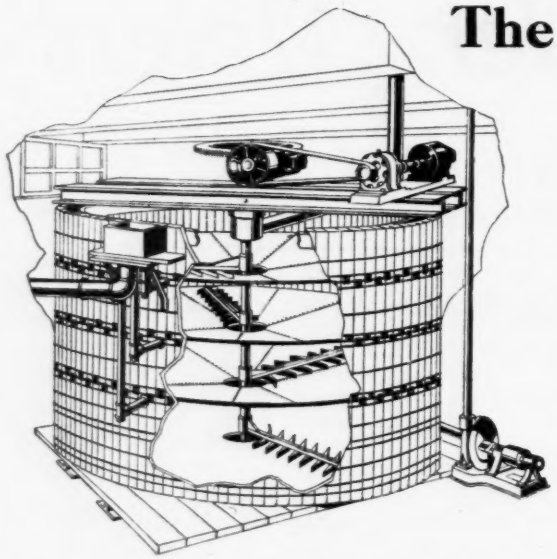

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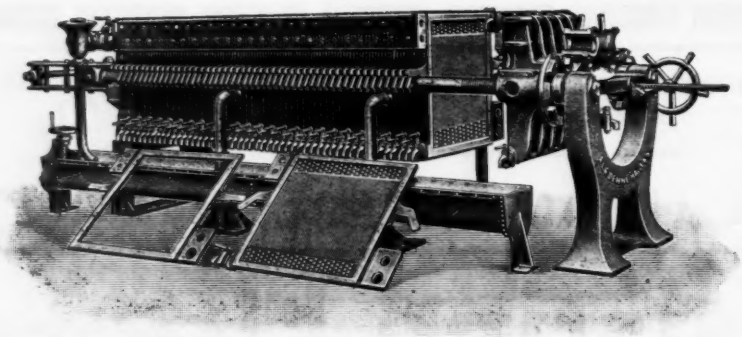

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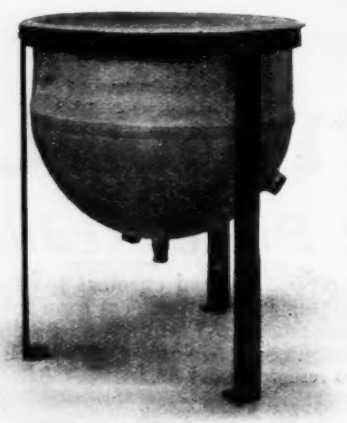

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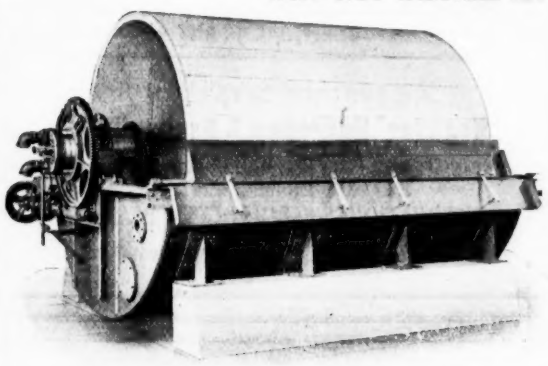

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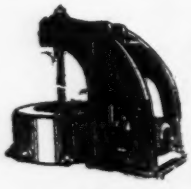

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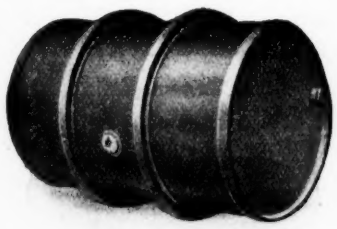

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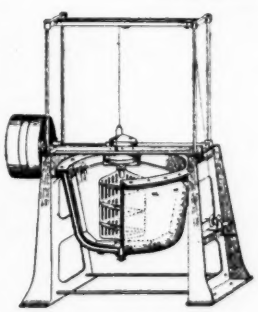

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RESEARCH CHEMISTS are required at the Building Research Station, Garston, Herts, the Chemical Research Laboratory, Teddington, the Fuel Research Station, East Greenwich, and local stations of the Physical and Chemical Survey of the National Coal Resources. Candidates should possess a good honours degree in chemistry or equivalent qualifications, and some research experience. Preference will be given, other things being equal, to ex-service candidates.

Further information, including particulars as to salary, together with the necessary form of application, may be obtained from the SECRETARY, Department of Scientific and Industrial Research, 16, Old Queen Street, S.W.1. Completed forms of application must be returned not later than July 11.

CITY OF BRADFORD.

THE Sewage Committee of the Bradford Corporation are contemplating the appointment of a SUPERVISOR of their Sulphuric Acid Plant.

Persons desirous of being considered should write to the undersigned stating (1) their experience in operating Mills-Packard Chamber Plants in combination with Harris Furnaces burning pyrites, and (2) salary required, before July 2, 1927.

H. WONTNER-SMITH,
Sewage Works Engineer.
Esholt Hall, near Shipley.

Patents and Trade Marks

IMPROVEMENTS IN AND RELATING TO THE PRODUCTION OF AROMATIC SULPHONIC ACIDS. British Patent No. 202,975 for disposal by sale or licence.—Particulars obtainable from TECHNICAL RECORDS, LTD., 59-60, Lincoln's Inn Fields, London, W.C.2.

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